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DISCOVERY OF NEW DRUGS FOR SPECIFIC THERAPY*

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INTRODUCTION

It may seem inconceivable but nevertheless it is true that the last 15 years (1930-45) have seen new discoveries in the field of therapeutics, which were not possible in over 3000 years from 1500 B C (as disclosed in the records of Ebers Papyrus of Egypt) to 1618-1766 B C, during which the first 3 editions of the London Pharmacopoeia appeared. Among the highlights of the recent therapeutic achievements may be mentioned the antimalarials, *e g*, Plasmochin and Atebrin in 1932-33, the anti-bacterials, *e g*, Prontosil and the members of the Sulphonamide family from 1935 to date, the immunologic remedies, *e g*, the new Cholera vaccine in 1944 remedies for the treatment of shock and war casualties with blood plasma and serum between 1942-44, the elaboration in a pure state from the blood proteins of the gamma-globulins for the prophylaxis and treatment of measles, etc., in 1944-45 the insecticides *e g* D D T and Gammexane for Malaria control etc., in 1942-44, the anti-biotics of the Penicillin group between 1942-45 and the latest discovery reported only a month ago, of a new anti-malarial claimed to be at least 10 times stronger than quinine from the laboratories of the Imperial Chemical Industries (London). It is peculiar to note that the war years (from 1939 to 1945), in spite of the wide-spread chaotic conditions associated therewith have produced the maximum number of discoveries in the realm of drugs. It is also of interest to note that most of these discoveries have emanated from pre-war Germany and later from Switzerland America and Great Britain, and that the time-lag between any individual discovery and its clinical application has been particularly short

TEAMWORK IN DRUG RESEARCH

A question that naturally arises before any inquisitive mind is how this phenomenal progress is made possible? Why some countries out of so many others could assume leadership in the elaboration of new drugs and in their almost immediate therapeutic application during the last decade or so? How is it that remedies for some of the tropical diseases *e g* Malaria Leishmaniasis, Trypanosomiasis, Schistosomiasis, Yellow

fever, etc, could emanate from countries where such diseases are almost non-existent? Why can't we in India emulate such examples and find remedies for such diseases as Leprosy, filariasis Leucoderma, Infantile hepatic cirrhosis, osteomalacia, etc, peculiar to India and adjoining tropical countries?

As is generally well recognised, the leadership in the field of new discoveries in synthetic and chemotherapeutic remedies was taken early in this century by Germany. An examination of the research organization and methods adopted by German scientists would therefore be expected to provide some clue to the queries referred to above. All records seem to indicate that from the time 'Antipyrine', the first synthetic drug to be introduced to the medical profession, was obtained at the Bayer Laboratories in 1888, the German chemists slowly but surely realized that a great future lay before synthetic organic chemistry and its application to medicine. German chemists, both in the commercial firms and in the Universities, intensified their efforts in the elaboration of new synthetics from various natural sources such as coal-tar, etc, but they were soon convinced that the help of pharmacologists, bacteriologists and clinicians is necessary in order to achieve any measure of success in this type of work. This realization made the Bayer Co., to start research laboratories within their works where a collaborative effort between the three types of scientists—chemists, pharmacologists and clinicians—could be fostered as in a 'team'. The first phenomenal success of this policy came through the discovery of Salvarsan by Ehrlich and Hata (1906-1908) and this was followed by a host of analgesics, and antipyretics (*e g*, phenacetin, pyramidon), hypnotics (*e g*, veronal luminal) anaesthetics (*e g*, novocain pantocain), and chemotherapeutic remedies for protozoal and bacterial infections (*e g*, prontosil, uleoron atebirin). Never before in history such a glorious chapter of new discoveries of drugs could be found as was recorded in Germany within the first 35-40 years of this century.

GREAT BRITAIN AND AMERICA FOLLOW GERMAN EXAMPLE

Scientific research was already well developed in the United Kingdom and in the United States of America and it did not take them long to see the benefit of 'collaborative research', as distinguished from 'individualistic methods' which were previously in vogue in these countries. The discovery of Sulphapyridine, Gammexane and the wonder drug, Penicillin, are all examples of fruits derived from conjoint efforts of various groups of scientists working for a common goal.

* Re-written and brought up-to-date from a talk given at the Pharmaceutical Department of the Benares Hindu University Benares 1945

In America, the principle of collaborative research has become the order of the day. Almost all the important drug manufacturing firms have set up their own comprehensive research laboratories where full facilities for team-work between chemists, pharmacologists, pharmacists, bacteriologists and clinical investigators are being offered. Many University authorities are also fostering such a programme within their own staff and are also freely permitting their technical men to work in liaison with scientists engaged in commercial firms for the solution of problems of industrial and applied interest. As a result of such co-operation of the Nation's 'brain-trust', discoveries such as DDT and penicillin, which are of tremendous significance to the health and welfare of the whole human race, have been possible. Prof J. D. Bernal¹, one of Britain's foremost thinkers, has clearly expressed the significant contributions of 'team research' of to-day in the following words, "Practically the whole of the great advances of science in the 20th century were achieved not by scientists working as individuals, but in organised groups."

THE BOTTLENECK IN INDIA

The failure of scientists in India and elsewhere in making worth-while contribution towards this type of progress is largely due to a lack of realization of the benefits of 'collaborative research'. Facilities for research, of course, are generally very limited in a poor country like India and an organization planned on the lines of the Bayer Co. Laboratories and other Laboratories in Great Britain and America cannot perhaps be thought of for many more years to come. But it is indeed a peculiar situation that even the few existing Governmental, University or commercial institutions have not developed any means by which co-operative work would be possible and an interchange of ideas and views effected. This 'closed-door' method is certainly not conducive to progress in any field of investigation, far less in the field of drug research where collaborative research is probably much more important to-day than the imagination, initiative and skill of even a gifted but isolated investigator. The bottleneck that exists in this field was strongly voiced in a recent symposium by a well-known organic chemist of Calcutta, a worker of proved ability and merit and who has been particularly successful in his synthesis of some sulphonamide compounds and who has also made significant contributions in his studies of the coal-tar medicinals including antimalarials of the acridine group. He complained that he could not make any positive statement regarding the efficacy of a new compound of the sulphonamide series which, from all his careful studies pertaining to its chemical constitution and anticipated pharmacotherapeutic effects, he had reason to believe would prove a boon as a remedy for gastro-intestinal affections of the bacillary dysentery and cholera-type prevalent in India. He had approached several State institutions for a disinterested pharmacologic and clinical study of his product but without success. Either the institutions are too busy with their own work or are not inclined to take up investigational work even on the payment of grants-in-aid or are not permitted by authorities to be associated with work emanating from a commercial

firm. The result is that no new remedy, even if it be really worthy, can be presented to the medical profession and people still continue to suffer when much suffering could probably have been relieved. If adequate pharmacological, chemotherapeutic and clinical trials could not be ensured, the discovery of Sulphonamides and Penicillin would still have remained mere chemical and micro-biological curiosities without the world-wide humanitarian use to which they are now employed.

NEW DRUGS AND THEIR SCIENTIFIC EVALUATION

In spite of the wonderful achievements of modern science it seems impossible to get the public and even some members of the scientific professions to think in scientific terms. The tendency still is to think in terms of the 18th Century rather than of the 2nd quarter of the 20th. During the 18th Century when medicine was pure empiricism, it was not only possible but also probable that the medicinal value of certain new products or a combination of products might be stumbled upon by those untrained and unskilled. That time has passed. Today, while it is theoretically not impossible, it is so improbable that there is no justification in thinking that any Tom, Dick or Harry, with a little tinkering of chemical knowledge or clinical experience, can discover new remedies for the alleviation of human suffering.

As the body of human knowledge broadens and deepens, it becomes increasingly difficult to make any material addition to it, without a very well-conceived and elaborate organisation and a planned attack by really qualified scientists. Such planned attack in the field of drugs must necessarily be tripartite between chemists, pharmacologists and clinicians. It is not a one man's job. The chemists would naturally initiate the attack by elaborating newer and newer compounds on the basis of already acquired knowledge regarding chemical constitution and clinical effectiveness. The pharmacologists must then provide discriminating data on (a) probable toxicity, (b) type and mode of action, (c) worthiness of application to human beings, and (d) reasonableness of replacing existing drugs. Such study requires caution, skill, precision in experimental technique and judgment, which are not easily available in many younger workers. The pharmacologic appraisal, furthermore, is usually a long-drawn and tedious process and, on an average, would require a three-to-one service ratio between pharmacologists and chemists in order to satisfy the needs of the latter. After pharmacological data are complete, clinical trial would always be necessary before any new drug can be introduced to the profession and the public. Otherwise, the clinician would run the risk of endangering human lives if he tries to transfer a new drug direct from a chemical laboratory to the clinic.

TYPES OF INVESTIGATION NECESSARY

It is the general consensus of opinion of modern scientists that all new drugs should pass through several phases of investigation before it is declared suitable for distribution in the open market. It should be studied

in the laboratory and clinically and all investigation should follow a general plan which will permit a thorough understanding both of its usefulness and of its toxic properties. Such a plan has been provided by Winkle, Herwick, Calvery and Smith² under authorisation of the Council of Pharmacy and Chemistry of the American Medical Association. This scheme is being briefly presented here with a view to enable all those interested in the evaluation of new drugs to appreciate the complexity of the task. It will further be of benefit to laboratory workers, pharmaceutical manufacturers, clinicians, pharmacologists, etc., in fact, to all those who may be called upon to undertake the investigation of new drugs.

SCHEME OF STUDY

(i) In the Laboratory —

(a) Biochemistry—General properties, including solubility and stability, studies of absorption, reabsorption, fate, distribution and excretion, mode of detoxification (excreted, unchanged, oxidised, reduced, acetylated?), effect of enzymes, blood and tissues, chemistry of body fluids and tissues, production of toxic products during course of metabolism.

(b) Pharmacodynamics—*Local* Test of irritation on skin, eye, alimentary canal, intradermal irritation, sensitivity or anaesthesia, tests of protoplasmic depression or toxicity, and reversibility of effects on cilia, nerve trunks, mucosa, haemolysis, antihæmolysis and blood pigment changes. *Systemic* Action on blood pressure, respiration, muscles, nervous system, cardiac function, secretions, temperature, voluntary activity, organ perfusion, isolated tissues, effects of vasomotor agents, fats, metals, solvents and other agents on the actions of the drug, cumulative effects, development of tachyphylaxis, quantitative and qualitative differences in action in different species of animals.

(c) Experimental Functional Pathology—Effect in experimentally induced pathologic states, e.g., smooth muscle spasms, hypodynamic heart fibrillations, and arrhythmias, hypertension, respiratory depression, oedema, shock, burns, anæmias.

(d) Chemotherapeutic—effects in preventing specific experimental infections, in combating experimental infections or actions of toxins, antagonists of chemotherapeutic agents, e.g., pus, serum, tissue products, distribution in inflammatory states, e.g., meningitis, dermatitis, minimal effective dosage (ED 50).

To this plan must be added a study of the toxicity of the preparation. This section of the work is important, and covers the study of acute and chronic toxicity of drugs and other chemical agents. The drug will not then be put on the market before the extent of its usefulness and the potentialities for harm are understood. The following outline for such toxicity work is suggested.

(a) Acute Toxicity—Dosage response curves in three or more species, objective symptoms, statistical calculations for comparative studies, simultaneous comparative determinations of other substances, variations in toxicity with method of administration.

(b) Subacute Toxicity—Large daily doses to one or more species for six to twelve weeks, microscopic pathology.

(c) Chronic Toxicity—Three or more species, at least one species for the life of the animal, several dosage levels graduated to produce from no effect up to pronounced lesions, and possible shortening of life span, microscopic pathology, effects on voluntary activity, e.g., running or other performance as evidence of more subtle functional changes.

(d) Local Effect—Sensitisation, skin irritation, mucous membrane irritation, photosensitisation.

(e) Special Studies—Reproduction, distribution and storage, effect of diet, effect of environment, kidney and liver function tests.

There are two important points here—the suggestion of using three or more species in acute and chronic toxicity evaluations and the proper selection of test animals, which must be carefully done.

At the end of those laboratory observations a critical review of the accumulated data should be made. The following points should be considered in an effort to reach a decision as to whether a clinical trial of the drug is justified —

1 Has the drug definite and desirable pharmacodynamic or chemotherapeutic actions?

2 Are its actions constant and reproducible?

3 Are these actions observed in different species of animals?

4 Is the mechanism by which its actions are produced a desirable one or are the actions the result of an ultimately undesirable reaction of the animal?

5 Are the effects obtained in animals in which experimentally produced pathologic or functional changes comparable to human diseases have been made?

6 What is the therapeutic index of the compound (ratio of effective dose to toxic dose, ED₅₀/LD₅₀)?

7 Are the undesirable side actions of sufficient importance and severity to militate against its clinical use?

8 Is there an adequate margin of safety in its use?

(ii) In the Clinic

If a clinical trial is indicated then the primary objectives in this branch should be (1) to determine the therapeutic efficacy, and (2) to detect all signs of clinical intolerance or toxicity. This work must be undertaken by competent investigators in co-operation with the pharmaceutical manufacturer. It is important to select an investigator who has proper qualifications and training in the particular phase of the problem requiring study.

In evaluating the results of the experimental and clinical studies of a new drug, the following factors should be considered —

1 For what conditions is the drug to be offered?

2 How effective is it in these conditions?

3 Is it superior to other drugs and methods of treatment?

4 What is its inherent toxicity?

5 Does its toxicity outweigh the therapeutic advantages keeping in mind the seriousness of the conditions for which it is being offered?

- 6 If there are other drugs equally or more effective in the same conditions, is the new drug less toxic or does it offer advantages in case of administration, duration of action and so on?
- 7 How extensive will the use of the drug be, are its applications limited?

'NEW' NAMES—NOT 'NEW' DRUGS

From the outline for the therapeutic and toxicologic appraisal of new drugs given above, the vast amount of work that is necessary in making a real contribution to this field would easily be appreciated. Though the above scheme of study need not apply in full to all cases, it is considered that the majority of agents should be tested by means such as are described. This might entail in some instances a certain amount of avoidable loss of time, but this is all the more to the good, since recent history contains too many instances of disastrous results that have followed incomplete or inadequate investigation of new drugs.

In countries where the above type of scientific study is not possible, either due to absence of trained personnel or to the lack of a collaborative organisation of different types of technical workers, there is only a very remote possibility of any new discovery in the realm of drugs emanating therefrom. It may almost be taken for granted that claims for any new discoveries from such countries are, more often than not, unreal and based on flimsy grounds which might not stand the test of time. These are mostly discoveries of *new names* for an already known drug or a combination of several known drugs, and not a *new discovery* in the true sense of the word. It is naturally a simpler path for the manufacturers to get their publicity officers to coin a new and catchy name for any nostrum, rather than go to the tremendous expense of maintaining a scientific organisation necessary for the study of synthetic compounds through all their difficult and complex phases often without any guarantee of their ultimate successful use in medicine. After all, it is known to everybody that out of 100 compounds thus studied, there may or may not be a single worthy compound. More than 1200 compounds were stated to be tested by the German workers led by Prof. Schulemann, the pharmacologist before plasmochin and atabrin could be discovered. The odds are therefore heavy against financing of drug research and only high idealism, associated with a full realisation of the benefits that might accrue to mankind in the event of even a chance success, can make such efforts possible. If success comes in the way, the undertaking of such research may prove a sound business proposition and this has actually happened in more than one instance, but the latter should not serve as the only objective.

POSSIBILITY OF SETTING UP DRUG RESEARCH ORGANISATION IN INDIA

In Germany, the necessary idealism and the spirit of adventure in the quest for the unknown were provided more than 40 years ago by a commercial concern, the Bayer Remedies, a concessionary of the I.G. Farbenindustrie Aktien-Gesellschaft. It is remarkable

that at the time when Bayer Co. organised their collaborative research programmes, the German academic faculties, in spite of their high scientific attainments in pure researches in chemistry and pharmacology, could not appreciate the tremendous significance of this type of applied research, and there is no record to indicate that the State authorities financed any similar studies in the various German academies. In Great Britain and America however, support for such research came freely from the State on the one hand and from private endowments and commercial enterprises on the other. As a result of this new attitude to drug research marvellous results have been achieved in the elaboration of the newer sulphonamides, penicillin, DDT, Gammexane, and a host of lesser known but equally significant remedies. America is making a quick march in this direction because munificent private donations from bodies such as the Rockefeller Foundation, etc., are easily forthcoming for research projects along with research grants from the American National Research Council. There is today no drug manufacturing firm worth the name in America which does not maintain a first-class research laboratory and a team of research workers. In addition, many firms support research work in University and Hospital centres by lump grants or through fellowship projects.

The same story can be repeated in India, possibly with equal amount of success, if there is only the *will* to do it. It is not the lack of scientific talent which is standing in the way, but the set-up of a really collaborative drug research organisation. The establishment of a National Institute for Drug Research where botanists, chemists, pharmacologists and clinicians would be able to join their heads and hands together in an effort to find out a new remedy either from vegetable, animal, mineral or synthetic sources has been suggested by the writer³ and has met with the approval of many medical and scientific organisations in this country. If private munificence and State aid are forthcoming, as is likely during the post-war period, such a project need not necessarily prove to be an ideal dream.

Pending the establishment of such a machinery, there seems a clear need for a re-orientation in outlook of some of our leading Indian Universities and State research institutions towards collaborative applied research. In University circles, there is often lacking that spirit of co-operation between several class of research workers, which might ensure a thorough checking of the products of their organic chemical laboratories. Departmental prestige and departmental output of research is often sedulously fostered, and this prevents any so-called 'outside' work being accepted. Friendly relations between departments and commercial research units in drug manufacturing firms are not often generously followed with the result that cross-fertilization of ideas, which are sometimes the foundations for 'creative' work (as distinguished from routine detail work), is never made possible. As matters stand at present, State institutions are the only centres where disinterested pharmacotherapeutic testing of new drugs is possible and positive collaboration from such centres should be freely forthcoming. Clinical research is

being supported by the Indian Research Fund Association and before long the crying need for clinical testing of drugs may perhaps be met to a certain extent. The urgent need now is for more 'Research Hospitals' where controlled clinical investigations could be conducted. Alternatively, 'research wards' could be set apart in public hospitals where members of the Pharmacology and Medicine faculties of the Medical Colleges would be free to conduct their investigational work.

THE ROLE OF THE DRUG MANUFACTURING FIRMS

To the drug manufacturing firms, medicine owes a great debt in assuming heavy financial risks in the promotion of new medicinals. Commercial firms, such as the Bayer Company in Germany, the Sandoz and the Roche Co. in Switzerland, the Burroughs Wellcome Co., British Drug Houses, May and Baker Co., etc., in England, the Lilly Laboratories, the Squibb Research Laboratories, Parke, Davis & Co., and others in America have enriched therapeutics by worthy contributions. They have supported teams of workers, sometimes for years together, in the hope of making new discoveries and their efforts have not been in vain. In fact, in drug research, more than in any other field, the contributions of the commercial firms rank on a higher level than that of University and State Research Institutions.

If India wishes to play a similar role, the drug manufacturing concerns must assume leadership in this line and start in right earnest to create their *individual* research laboratories on the 'team' principle or where financial obligations would not permit, *group* laboratories, jointly supported to cater for the needs of their supporters. Alternatively, the Indian Chemical Manufacturers' Association, which represents the majority of Indian chemical and pharmaceutical manufacturers, may be asked to set up a control and research Laboratory on the lines of the Laboratory maintained by the American Drug Manufacturers' Association. Barring the right type of scientifically minded clinical investigators (which are unfortunately not many in India, as medicine is still being practised as a *profession* and not as a *science*) almost all other types of workers, e.g., synthetic chemists, botanists, pharmacologists, bacteriologists, etc., would now be available in this country. A start must be made and only then would the right type of personnel be forthcoming. Once the realization comes of the benefit of such collaborative research, private institutions of the type of Mellon Institute at Pittsburg and the Nuffield Institute at Oxford would not be long in coming in India.

It is a happy augury of the times that a distinct awakening towards promotion of research by commercial firms is making itself evident in India. There are at least two firms in Calcutta* and one firm in Bombay† which are systematically supporting research in their own Laboratories. There may be others with which the writer is not acquainted. One of these firms has gone so far as to offer research grants to Government institutions and University Laboratories towards the furtherance of pure research unconnected in any way with their own

manufacturing problems. Recently, this firm has produced a report of research work carried out under the guidance of its Research Association, which provides a stimulating reading and indicates a proper appreciation of the requirements of drug research work. It is certainly going ahead in the proper direction and setting an illustrious example for others to follow. Only by such ways and through year-to-year painstaking and systematic study can India hope to figure in the scientific world and discover new remedies for the cure and alleviation of many diseases peculiar to her soil. There is no royal and easy road. No specific 'cure' (other than 'faith cure', of course) can suddenly be discovered through a flight of imagination. True, discoveries are often products of 'chance', but such 'chance' comes only to those who are in the thick of the fight and who are trained to recognise it.

SUMMARY

Discovery of new drugs, once an open field for all newcomers, is today becoming more and more a matter calling for the most intensive special qualifications. Further, it needs, in addition, a collaborative effort between various types of scientists of the best calibre. The secret of success of countries such as Germany, Switzerland, Great Britain and America in elaborating new drugs for specific therapy is found on ultimate analysis to be a collaborative effort between chemists, pharmacologists, and clinicians. Such collaborative effort has been made possible in Germany and Switzerland through enterprising and far-seeing commercial concerns and in Great Britain and America through State help, private endowments, and also the support of commercial concerns. In drug research, the objective should primarily be towards discoveries for the benefit of the human race, and only secondarily to financial considerations. Immediate results should not be expected, as sometimes long-drawn and painstaking work has been productive of no significant results. However, the success that has already been achieved proves without doubt that further success should not be beyond the reach of any honest group of investigators. India and many other countries have remained backward in this type of work. This backwardness is probably not so much due to the lack of talented scientific personnel as to lack of a collaborative organisation and joint efforts. Provided the will and leadership is available, India can figure in this field of research by developing better cooperative work between existing institutions and stimulating more research efforts in commercial concerns. There seems to be an awakening in this direction as a result of the second world war, and the present time seems to be most opportune to go ahead with elaborate and comprehensive schemes. Money spent will not be lost, but may come back in the form of better national health and national fitness.

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MALARIA TOXIN AND ACTION OF QUININE IN CLINICAL MALARIA

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Malarial ague has long been known to start simultaneously with the breaking up of the rosettes. These rosettes liberate besides the young merozoites, hæmozoin pigments. It has been asserted that a toxin is also liberated at the same time, and it is this toxin which gives rise to the clinical symptoms. The nature of this toxin has not yet been determined, but the ague simulates hæmoclastic shock caused by sudden liberation of toxin. Rosenau and others by injecting filtered serum procured during the cold stage have been able to demonstrate its presence (Manson, 1917). However, this particular toxin has not yet been identified.

The hæmozoin pigments are more or less extensively distributed throughout the body. They have been found in the brain and spleen after death from cerebral malaria even when no parasites are present (Viswanathan, 1944). In fact their presence in the body without the parasites is evidence of recent malaria. These granules are found wherever there is any pathological lesion. A lesion is seldom found without the simultaneous existence of these pigments. They are almost co-existent. The degree and extension of pigmentation as well as those of the retrograde changes in the tissues and organs largely depend upon (1) the type of infection, (2) its virulence and (3) the distribution of parasites (Solis-Cohen and Solis-Cohen, 1916). These pigments are distinguishable from those found in other diseases by being both extra and intravascular.

It has been observed that as soon as the hæmozoin pigments are delivered into the liquor sanguinis they are vigorously attacked by the leucocytes which have been found to increase even upto 30,000 in cases of severe infection (Manson, *loc cit*). Leucocytosis occurs during paroxysm (Stitt, 1922, Megaw, 1942, Manson-Bahr, 1944). These attacks go on everywhere in the body in the circulation, spleen, liver, intestine and in fact in every part of the body where the pigments gain access. 'The splenic vein direct from a rich breeding ground contains a large number of hæmozoin-laden leucocytes' (Manson, *loc cit*).

These pigments have been regarded by Manson as 'specific product' of the malaria parasites themselves. Banerjee and Bhattacharjee (1943) think that they have a toxic action which produces cloudy swelling and degeneration of the phagocytic cells. Viswanathan (*loc cit*) found degeneration of endothelium, the cells of which contained pigments. Hæmozoin may act as hæmolysin (Manson-Bahr, *loc cit*). Stitt (*loc cit*) thinks along with Brown that they can also bring about degeneration of the endothelial cells by being taken up by them, with associated capillary hæmorrhages. The toxic nature of the pigments may also be deduced from their behaviour prior to the rupture of the red cells. The segmenting schizonts except in cases of *P. vivax* are never big enough to so distend

the walls of the red cells as to cause their rupture. It seems more probable that the walls get disintegrated through the action of the toxin liberated from the pigments. As the schizonts begin to segment the pigments, which were located mainly at the periphery, are discharged from the body of the parasites and occupy a central place surrounded by the segments so that their toxin may not act prematurely on the cell walls before the merozoites are fit for liberation. When the merozoites are completely separated from one another, toxin from the central accumulation of pigments reaches the wall through the channels running between the segments, and disintegrate it in the same way as the endothelial cells are disintegrated. As a result the merozoites are liberated into the liquor sanguinis.

Leucocytes are considered to be the advance-guards, the first line of defence, against invading forces. From the beginning of invasion, that is, the onset of clinical symptoms these advance-guards attack the hæmozoin pigments to the exclusion of the parasites, which are seldom phagocytosed in the peripheral circulation. Therefore these pigments must be considered to be of primary importance among the invading forces. They persist even after the parasites have disappeared from the body, and disease continues sometimes culminating in the victory of the invaders. Or again the fight continues to such a pitch that the parasites too are attacked in the peripheral circulation as in Das Gupta and Ganguli's case (1944). But here again the schizonts only are phagocytosed to the exclusion of the rings and gametocytes although these latter are much smaller in size. The rational explanation of such a phenomenon lies in the fact that neither the rings nor the gametocytes are of importance, since they are not likely to supply reinforcement soon for a fresh onslaught, while the natural function of the leucocytes tells them that the schizonts have been bringing fresh contingent for the fight and must be destroyed forthwith without giving the enemy an opportunity to start the fight over again. The rings are hyaline bodies and do not contain pigment until they are fairly developed, neither are they likely to deliver the pigments, and so do not provoke the leucocytes to action. Similarly, the gametocytes, though they contain a few pigments, are not likely to set them free and cause mischief. Consequently the leucocytes do not take any notice of them. Perhaps herein lies the secret of relapse even in adequately treated cases. It is not the parasites 'lurking in the cells of the reticuloendothelial system' that escape from the action of quinine, since it never had any action on them, but that they being innocent do not stimulate the system to phagocytic action.

Hæmozoin pigments are, therefore, the repository of the toxin which produces pathological changes in the body giving rise to different symptoms in connection with malaria. In the blood it causes destruction of the platelets (Beattie and Dickson, 1921) and the red cells not attributable to the direct action of the parasites. In the spleen it causes thrombosis and focal necrosis (Solis-Cohen and Solis-Cohen, *loc cit*), liver hepatitis, kidney nephritis, in the brain the varied symptom according to the particular area affected, and so on. In the vessels it produces pathological changes in the

endothelium. Blocking, which is considered to be the cause of the cerebral symptoms, is secondary to these degenerative changes as suggested by Viswanathan (*loc cit*). Presence of parasites, according to him, inside or outside the cells is immaterial so far as clumping is concerned. Emboli are not found in the hyperpyrexial and hæmorrhagic malaria (Magaw, *loc cit*). Sinus thrombosis observed by Viswanathan was probably caused by dangerous fall of blood pressure due to large doses of quinine given intravenously. He did not find the pressure below normal in any of those cases before the commencement of treatment. Unfortunately he does not state the record of pressure during the course of treatment. Lack (1943) from observation on infected canaries found transient sticking of leucocytes to the endothelial lining of the venules plus evidence of plasma leakage, followed later by clumping of both infected and healthy cells, retardation of the rate of flow and pastelike flow of blood. There must have been some damage of the endothelial cells to account for the sticking of leucocytes. Viswanathan found no evidence of inflammation or necrosis of the brain. 'Intravascular thrombosis and consequent avascularization' according to him 'is the cause of malarial coma and death'. Punctiform and other hæmorrhages are probably due to deficiency of blood platelets and damaged endothelial cells.

Devine and Fulton (1941) found the crude hæmazon pigments to contain only about one sixth of hæmazon, which is chemically and spectroscopically indistinguishable from hæmatin, and the rest primarily of 'parasitic protein' which remains undissolved round the pigment granules. This protein envelope seems to be the toxic product of the parasites. It may be that a part of it goes into the circulation from which Rosenau and others could demonstrate its presence.

Therefore, it is the toxin and not the parasite that is of prime importance. And the pigments are store-houses of this toxin.

Having established this let us see how quinine acts in effecting cure of clinical malaria. Opinion differs regarding its mode of action in malaria. There are several views which may be summarised as (1) direct action on the parasites and (2) indirect action on them through the defensive mechanism of the body. Quinine disintegrates plasmodium *in vitro* in a concentration of 1 in 10,000. But this concentration is never reached in human blood, in fact it never exceeds 1 in 100,000. Besides it is rapidly excreted, 90% disappearing within a minute after intravenous injection (Ghosh, 1944). Morgenroth (1918) found the quinine content of the blood to be 1 in 20,000 a few minutes after intravenous injections and 1 in 150,000 after oral administration of therapeutic doses. 'Part of the drug is deposited in the spleen, liver and other organs in an inert form' (Megaw, *loc cit*). Maximum concentration is retained in the human blood for only half an hour (Chopra *et al* 1934). To maintain a steady maximum to be effective, if it is effective at all, against the parasites quinine has to be given every half an hour which is never done. Therefore, owing to low concentration, rapid elimination and partial transformation it cannot act as a parasiticide in the human body. De Sandro

(1909) says, 'most of the quinine injected (hypodermically) is found in the spleen where it reaches after an interval of fifty minutes, and it remains there longer than in any other part of the body and can be demonstrated even twenty-four hours after the injection'. But in spite of this the parasites accumulate and remain there for a pretty long time and produce relapse. It can neither prevent infection even when the blood is saturated with quinine (Megaw, *loc cit*). If quinine had acted as a parasiticide within a minute after an intravenous injection a large number of parasites should have been destroyed. But on the contrary in Gavan Duffy's (1944) case we find the parasites increase by 150% after 16 grains had been administered intravenously. Similar increase has also been observed by Chopra and others (1932). Again their rapid destruction should have been followed by aggravation of symptoms owing to sudden liberation of a large amount of toxin. This, however, never occurs. Small doses of quinine quite incapable of destroying parasites, of course, sometimes wake up latent malaria and bring about an ague. But this may be explained by the fact that such doses by causing contraction of the spleen (Cushney, 1936, Ghosh, *loc cit*) squeeze out the parasites. I am in the habit of giving parenterally 10 grains of quinine without any stimulant and repeating it after two hours, sometimes 20 grains in a single dose in apparently hopeless cases of algid or choleraic malaria with dramatic effect. Less than 10 grains in a dose is never given whether the patient is 30 years or 30 days old. The pulse appears at the wrist, temperature rises and evacuation stops within a very short time. Hundreds of such cases have been treated with uniform success. No aggravation of symptoms nor any depression of the cardiovascular system has been noticed. Intramuscular route is invariably used. Megaw's charts also show how quick and large doses act rapidly in controlling pulse and temperature, while small and leisurely administration delays action sometimes with disastrous result.

To clear up this confusion different workers offer different explanations none of which is, however, convincing. They are (1) that quinine acts on the merozoites but not on the sporozoites, (2) that the mature schizonts but not the rings are affected, (3) that it acts by making the red cells impervious to the merozoites, (4) that it makes the red cells more pervious for the 'all sufficient' serum to act on the parasites within the cells. There is no reason why it could not destroy the sporozoites, both are extra-corporeal, of the same nature and constitution though different in shape and origin, and both enter the red cells and develop into rings. Similarly, the schizonts and rings are of the same constitution and intracorporeal. If one is affected why not the other? Again if a coating on the cell wall can prevent entrance why can it not prevent egress as well? In birds inoculated with *P. Gallinaceum* intense quininization could not prevent the merozoites from entering the red cells, neither could it destroy the parasites, which not only survived in liquor sanguinis saturated with quinine but thrived and multiplied as well. The only thing quinine could do was to arrest the growth of intracorporeal merozoites.

and keep the erythrocytic schizogony of pigmented form in abeyance so long as quinine is in sufficient concentration in the blood (Adler and Tchernomoretz, 1941, 1943). Some ingredient in liquor sanguinis which is essential to the growth of the parasites is prevented by quinine from reaching the intra-corporal merozoites. The inevitable conclusion, therefore, is that quinine does not cure malaria by destroying the parasites.

As regards the second view, phagocytosis of plasmodium undoubtedly occurs both in the peripheral blood as well as in the spleen, but symptoms persist even after complete disappearance of parasites in cases where sufficient quinine has been given for a pretty long time (Viswanathan, *loc cit*). Besides prolonged administration of quinine often fails to completely liquidate the parasites and prevent relapse. Moreover, quinine causes a preliminary leucopenia before increasing the leucocytes (Ghosh, *loc cit*). Should not therefore, there be an initial aggravation of symptoms? Das Gupta and Ganguli's (*loc cit*) case put up a heroic fight even in a starving condition without the aid of quinine before yielding to the enemy. He was a destitute wandering in the streets of Calcutta for a morsel of bread and could not possibly have any quinine which was then selling at one rupee a grain. Even such extreme phagocytosis of parasites as observed by them did not require the help of quinine, neither could it save the patient. So quinine does not cure malaria through phagocytosis.

How then does it act? It acts on the immediate cause of the symptoms thereby relieving them. If toxin is the cause of the symptoms and there could be no question about it quinine must act on this toxin. Phagocytes devour the parasites and the pigments, but they cannot destroy the toxin. Quinine does it.

Gupta and Ganguli (1944) found that malaria-infected monkeys tolerated much bigger doses of quinine than noninfected ones. In fact they required higher doses to save themselves. They think that it is absorbed by the parasites thereby relieving the cells of the hosts from its toxic action. If quinine could be absorbed by the parasites how could extra erythrocytic multiplication be possible in the experimental birds of Adler and Tchernomoretz? Where then does this excess quinine go? Howie and Murray-Lyon (1943) observed that in acute subtertian malaria when quinine was not excreted in any urine the condition of the patient remained grave and could only be improved by injecting more quinine intravenously when the drug was detected in the urine as well. Again those who excrete the drug regularly improve rapidly. Ordinarily about one-third of the quinine absorbed appears in the urine (Cushney, *loc cit*). Where then does this lost quinine go? What is it required for? Kelsey and Oldham (1943) from studies on quinine oxidase in the tissues found some activity of this enzyme in human liver. During an attack of malaria this activity may be increased and be responsible for the disappearance of the quinine. Gupta and Ganguli (*loc cit*) do not consider it likely that the destruction is greatly accelerated by the malarial infection. However, if there is greater destruction, or shall we say utilization, there is greater

requirement as well, in such cases. The efficiency of the reticulo-endothelial system as measured by the congo-red index is increased in infected monkeys where infection is controlled by quinine and the general condition improved (Gupta and Ganguli, *loc cit*). This increased efficiency is probably due to the elimination of the toxin by quinine, since in unchecked malaria this efficiency is diminished, apparently due to the deleterious action of the increasing amount of toxin liberated by the increasing number of parasites on the system. So it is not the parasite that absorbs it, neither does the red cell absorb it, nor is it destroyed by the enzyme merely for the sake of destruction. It renders the toxin innocuous either by adsorption or by some delicate chemical reaction with it. The result is that neither quinine nor the toxin is capable of exerting its individual specific influence on the host. When sufficient quinine is not given to neutralise the whole of the toxin there is no surplus left to be excreted and the action of the unaffected part of the toxin persists. To be spared for excretion after neutralizing all the toxin, more than sufficient should be administered, when both improvement of clinical condition as well as Tanret reaction are obtained. A third condition may be possible where the quantity of quinine is nothing more nor less than what is absolutely necessary for complete neutralization of the toxin. Here no quinine will be detected in the urine, but the disease will be cured. Since it is impossible to measure the quantity of the toxin it will be a mere chance when this state would be obtained. If the target is not known the bullet will more often than not fall short of the mark or pass beyond it. An ideal dose would be one which leaves a constant trace of quinine in the urine throughout the course of acute attack and gives a faint Tanret reaction. If administration of quinine is stopped before the defensive mechanism of the body is sufficiently developed early relapse is likely, for, we find the dormant merozoites in the red cells developing into schizonts when quinine is eliminated or its concentration in blood is sufficiently lowered (Adler and Tchernomoretz, *loc cit*).

The questions that can arise in connection with the action of quinine are, (1) how could infected monkeys tolerate more quinine than what would otherwise have killed them, (2) why quinine sometimes fails to appear in the urine during the course of treatment in acute malaria, (3) why should bigger doses be required by children than their age and weight call for, and (4) why prophylactic use of quinine cannot prevent relapse?

If we accept that quinine acts as an antitoxin all these points can be satisfactorily explained. More quinine is tolerated because the excess is required to neutralize the toxin thereby relieving the cells of the host from its toxic action. Secondly, quinine fails to appear in the urine because of the change in its constitution in the process of neutralization of the toxin. As regards the third point, children have not acquired any immunity which can at least partly control the toxin as happens with the adults, besides the average number of parasites in their blood is about one hundred times that of adult in the same endemic area (Napier, 1943).

Hence more quinine is required to neutralize unaided the greater amount of toxin liberated. Fourthly, relapse cannot be prevented even after administration of quinine in prophylactic doses extending over a period of even twelve months, in fact after the stoppage of the prophylaxis the incidence of relapse is actually higher than in those receiving no prophylactic treatment (Field, Niven and Hodgkin, 1937). This is due to the fact that while quinine could not eradicate or prevent entrance of parasites, by constant presence in the blood it neutralises the toxin whenever it is liberated by the parasites. Absence of free toxin in the system prevents the growth of immunity in the host. Consequently when the drug is withdrawn relapse occurs uncontrolled by any immunity. So from whatever angle it is seen the only possible conclusion is that quinine acts as an antitoxin.

SUMMARY AND CONCLUSION

Pathology of malaria and its relationship with the hæmoglobin pigments are discussed. Hæmoglobin pigments are the repository of the toxin which produces the morbid changes giving rise to the varied symptoms of clinical malaria.

Fallacies of the current views on the action of quinine in malaria are pointed out and a new theory, that quinine acts as an antitoxin by combining with the toxin whether by adsorption or by some other delicate chemical reaction is enunciated.

My thanks are due to Mr S Neogi, M.Sc., Khulna, and my nephew Mr J C Das Gupta, M.Sc., of Messrs Bathgate & Co, Calcutta, for the great encouragement and suggestions received.

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(Continued from page 45)

The secondary anaemia rapidly clears up with iron, while the appetite may have to be stimulated in some cases with the help of stomachics. The diet should be ample and nutritious.

ACKNOWLEDGEMENT

My grateful thanks are due to my chief, Prof Sahai for helpful advice, and to Dr Akhtar Husain of Fyzabad and Dr J K. Das of Lucknow for referring some cases to me.

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 N.B.—This paper was written in Feb, 1945. Since then over a dozen other cases have been seen by me, and a couple of previous cases have returned with a relapse.
 A peculiar feature seems to be the apparent frequency with which medical men get these cases, the probable explanation being that they are more carefully investigated.
 Another important point is the optimistic note of the editorial article, wherein it is suggested that intravenous arsenic can effect a quick and complete cure. This optimism has not been justified by subsequent experience. Relapses have been found to be not infrequent, and more than one case of apparent true Benign Eosinophilia has either not responded at all or only poorly with arseno-therapy.

(Continued from page 47)

ACKNOWLEDGMENT

My thanks are due to Major-General H C Buckley, M.D., F.R.C.S., C.S.I., I.M.S., Principal Medical College and Superintendent, Thomason Hospital, Agartala for his kind permission to publish the record of the case.

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IDIOPATHIC PULMO-EOSINOPHILAEMIA

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HISTORICAL

Considerable interest has been aroused in this country since the publication in 1940 by the late Frimodt-Møller and Barton (1940) of 175 cases with a symptom complex which they, rather unfortunately, labelled 'pseudo-tuberculosis with eosinophilia'. This symptom-complex was selected out of a total number of 5,500 cases which passed through their hands in the Madanapalli Sanatorium, Madras, between 1925 and 1940. These cases were sent to them as cases of pulmonary tuberculosis with low fever, cough with expectoration, occasional haemoptysis, loss of weight, characteristic x-ray picture and marked eosinophilia, but the sputum was consistently negative for tubercle bacillus. They did not suggest any particular line of treatment but stressed its nonspecific and benign nature.

Later, Weingarten (1943), under the heading 'tropical eosinophilia', reported 81 cases observed in Bombay between 1933 and 1942. He found spleen enlargement in a large number of cases during the acute and subacute phase and reported the 'happy' coincidence of a patient, under observation for the above condition, contracting syphilis for which he was treated with neoarsphenamine, which not only cured his syphilis but also the eosinophilic state. In view, however, of the report of Greval (1940) and Gupta (1945) who found a positive W R (but negative Kahn test) in some cases of eosinophilia in the absence of any history or other signs of syphilis, one wonders whether Weingarten's case was really suffering from syphilis also.

Treu (1943) from Calcutta reported two cases, one of whom was cured by a few doses of acetylarsan, while the other got pneumonia, which cleared off the eosinophilic state.

Simeon (1943) from Bombay reported 35 cases in 9 years and found spleen enlargement in 50 per cent of cases and suggested the name Benign Eosinophilic Leukæmia, which seems as unhappy a choice as that of Frimodt Møller's because leukaemia is an universally fatal condition*.

Chaudhry (1943), Chakravarty & Roy (1943) and Shah (1943) reported one case each.

My interest was attracted when I saw a case, about 14 months ago. This patient had been diagnosed as suffering from pulmonary tuberculosis and had been sent to a sanatorium where he stayed for 4 months without any benefit. He had low fever, spasmodic cough with scanty expectoration for about 14 months, occasional slight haemoptysis, loss of appetite and weight. Clinical examination showed a pale and thin young man of 28 years, with generalised signs of bronchitis, harsh breath sounds with a few rhonchi and medium crepitations persisting after cough. The signs

were more marked on the left midzone. The sputum was persistently negative for tubercle bacillus (even by the concentration method), though it showed a large number of eosinophils, while the x-ray showed generalised fibrosis with diffusely scattered infiltrations suggesting submiliary tuberculosis or pneumokoniosis. The blood count showed a fair degree of microcytic anaemia, while the total white blood cell count was 23,000, and the differential count showed eosinophils 70 per cent. The spleen was not palpable, though he came from a zone of endemic malaria (Gorakhpur District). He had never been near the sea. There was no previous personal or family history of asthma, though the coughing at times became paroxysmal in character. He was put on a stimulant expectorant mixture. In addition he was given intravenous injections of "soamin"—a pentavalent arsenical, the first dose being gr 1, dissolved in 2 c.c. of sterile distilled water (to test his sensitivity to arsenic) and subsequently gr 1 in 5 c.c. of sterile distilled water given twice a week for 3 weeks (a total of 19 grains). He made an uninterrupted recovery, became afebrile and put on weight. His cough disappeared and the blood count returned to normal level. Unfortunately a second x-ray could not be taken. He went home just a year ago and has maintained good health.

Since then 7 more cases have been seen and the following account is based on them, and on the literature available on the subject.

DEFINITION

A symptom-complex characterised by a long chronic duration and more or less benign course with low fever, cough (which may be occasionally spasmodic in character), scanty expectoration, occasional haemoptysis, loss of weight, marked relative and absolute eosinophilia, characteristic x-ray appearances and showing a dramatic response to intravenous arsenotherapy. Various names have been suggested. Frimodt Møller's 'pseudo-tuberculosis' is a very unfortunate choice because of the tragic association with tuberculosis. Weingarten's 'tropical eosinophilia' is not so bad, but seems to suggest an artificial geographical narrowness which may not be correct. Simeon's 'benign eosinophil leukæmia' is also unsuitable because leukæmia is always associated with a fatal ending. The author suggests the name 'idiopathic pulmo-eosinophilia'.

AETIOLOGY

No age seems to be exempt. The youngest case seen by me being only 2 years old, while the oldest was over 50 years of age. Both sexes are prone to it, as also all strata of society. Weingarten suggests some correlation with the seaside, but none of my cases had ever gone beyond the UP. There appears to be a special seasonal prevalence, the condition being more common during the cold season. Diet, alcohol, tobacco, colour of the skin (white, brown, or black) show no significant association and no history of past illness appears to be of any importance. No autopsy has yet been made on any case of this disease.

SYMPTOMS AND SIGNS

Some cases seem to have an acute onset with fever going up to 101-102°F, followed a few days later

* Simeon was partly justified in using the term leukæmia because he had qualified it by the prefix 'benign'—EDITOR, J.I.M.A.

by troublesome cough which tends to be spasmodic at times and may resemble a mild attack of asthma. Enlargement of spleen has been reported in many cases by Weingarten and Simeon though this is not my experience. After some time, the fever tends to go down and a chronic phase is entered, which may last for a long time. Many patients say that the onset was like an attack of coryza—a mild 'influenza'—which later became chronic. In the majority, an insidious onset is observed with low temperature, troublesome cough, which gets worse as time passes and is often frankly spasmodic in character with audible wheezing. The sputum is scanty and mucoid and not infrequently frankly blood-stained. Gradual loss of appetite, loss of weight and increasing weakness and pallor are observed. Sleep is much disturbed by cough which is specially troublesome at night.

Physical examination shows the patient to be thin (with definite loss of weight) and anæmic. The temperature varies between 99 and 100°F. The pulse is rather rapid. Weingarten and Simeon have described a well marked splenomegaly during the acute and subacute phase, but I have not yet observed this sign.

The chest is bilaterally symmetrical with equal movement on both sides. Vocal fremitus is unaltered while the percussion note tends to be hyperresonant. Auscultation reveals harsh breath sounds with prolonged expiration many bronchi in the early stages which are later replaced by medium crepitations which persist after coughing. Vocal resonance shows no change. Sputum will always be found negative for tubercle bacilli but contains the usual bacterial flora and a large number of eosinophil cells but Charcot-Leyden crystals and Curshmann's spirals have not been reported. Several workers have recently reported the finding of mites in the sputum of their cases and attach a causative significance. Sputum examinations in the recent cases have been persistently negative for mites. Blood examination reveals a moderate degree of secondary anaemia, but the most characteristic feature is marked leucocytosis which may vary from 20,000 to over 100,000 cells per cmm, while the absolute numbers of the neutrophils and the lymphocytes are usually unaltered. Simeon comments on the very 'mature' and multinucleated character of the eosinophil cells. The x-ray examination reveals a startling condition very suggestive of miliary or submiliary tuberculosis or pneumokoniosis. In other cases the lungs present a marked degree of diffuse fibrosis.

DIAGNOSIS AND DISCUSSION

The diagnosis is not difficult if the condition is kept in mind in all cases of persistent cough. This is helped by the examination of a blood film. Miliary tuberculosis is a very much more acute condition and is invariably fatal within a few weeks. Considerable difficulty may be experienced in separating this condition from bronchial asthma but the paroxysms are much less severe (though relieved by adrenalin and ephedrin) while in asthma the blood count is seldom over 15,000 and the eosinophils are under 20 per cent and there

no febrile reaction. Moreover, no case has been reported from Europe where asthma is common. From chronic bronchitis the differentiation is only possible by the examination of a blood film, this will also exclude pneumokoniosis or syphilis of the lung. Loeffler's syndrome is somewhat like this but its duration is only for a week and it is a self-curing condition.

The other conditions which produce eosinophilia are anaphylactic states, certain skin diseases and helminthic infestation of the bowels, but in these conditions the eosinophils are seldom above 15-20 per cent.

Finally eosinophil leukaemia has to be kept in mind, but in this the cells are always very immature and often one-lobed thus making differentiation easy.

The exact aetiological agent is not known. The apparent resemblance to bronchial asthma may at times be striking, and suggests a possible method of approach, *viz.*, to try and discover some anaphylactogen. Another possibility is some organismal infection for which sputum culture, separation of the various organisms present, and an attempt to test for their agglutination with the patient's serum is being tried by us. The dramatic response to arsenicals suggests a similar cause.

PROGNOSIS

Prognosis is good, once the diagnosis is made and appropriate treatment instituted. No fatalities have so far been reported.

TREATMENT

Frimodt Möller (1940) reported 175 cases which had been observed for a number of years, but could suggest no specific line of treatment.

Weingarten (1943) in reporting his 81 cases described the accidental discovery of the specific effect of arsenicals, as already mentioned above. He employed neo-arsphenamine intravenously with brilliant results. He also suggested that oral use of arsenicals like stovarsol might also have a curative effect. Treu (1943) used acetylarsan, and Simeon (1943) mapharside, with success.

It is undoubtedly true, as has been amply confirmed from my personal experience that the arsenicals act as a specific by the intravenous route. Usually 6 to 8 injections of 2-3 c.c. acetylarsan or N. A. B. or mapharside or about 20 grains of soamin produce a cure.

It is interesting to record that, in our hospital we have been using soamin injections for nearly 20 years with good results in some cases, but with little success in others. One surmises that the successes were in cases suffering from this disease and not from true asthma.

In addition, stimulant expectorants with iodides are given to clear up the lung condition. Antispasmodics like tincture lobelia etheris and tincture stramonium or ephedrine are given in cases with spasm, where spasms are particularly troublesome, adrenalin 1 in 1000 in aqueous solution or in oil is of great help.

(Continued on page 22, col. 2)

MALARIAL NEPHRITIS

with an illustrative case report

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HISTORICAL

There is paucity of records in the literature dealing with the study regarding the pathological effects of malarial infection on kidneys. Slight albuminuria in malaria has very often been observed but one has attached no serious significance to it because presence of transient albuminuria is quite common during any fever.

One has to go back to 1891 when glomerular nephritis in quartan malaria was reported by Marchiafava and Bignami. In 1912 Clark went so far as to say that in the tropics albuminuria was an indication for searching for quartan malarial parasites, or for syphilis. Four years later Deeks (1916) opined that nephritis was one of the commonest complications of malaria. This was an outcome of his experience after working in the Panama Canal Zone. Manson-Bahr and Maybury (1927) and Ghilohi (1930) reported the occurrence of nephritis as a complication of malaria caused by *Plasmodium malariae*.

Fresh interest in this subject has been revived by Heilig (1941, 1942). He reported (1941) that in four out of six cases of acute glomerulonephritis there was a clear association with malaria, and that all these four cases responded well to quinine therapy, whereas the other two patients were discharged with laboratory evidence of permanently damaged kidneys. He established his opinion on the etiology of the nephritis to be malarial infection mainly on the response to quinine. He showed the excellent diuretic action of quinine in this condition. Heilig is of opinion that his cases were caused by *P. vivax*. Laha (1945) reported two cases of malarial nephritis. One of his cases was completely cured. The other case made a considerable improvement but he died of terminal uraemia after about two months in spite of the initial improvement. Postmortem findings of Laha's second case revealed amyloid degeneration of kidneys, liver and spleen in addition to nephritic changes (nephrotic type) in the kidneys.

In the case reported below it has been shown that the infection was of mixed type (*P. vivax* and *P. falciparum*). The next point of importance has been the failure of mepacrine therapy to strike any improvement. Rather it aggravated the lesion. There is no record regarding the effect of mepacrine in malarial nephritis.

CASE REPORT

H.C., 10 years, Hindu male child, was admitted into the hospital with the complaints of—generalised oedema and diminished urinary output, duration 4 months. For the last 16 months he was getting occasional attacks of rigor and fever, pain in the abdomen and transient generalised oedema. Such an attack used to last for a few days only and then sub-

side completely. He used to take some village treatment.

On examination—The patient had universal oedema with markedly swollen penis and scrotum, was pale, and pulse and respiration rates were 120 and 28 per minute respectively, weight 3 stones and 8 pounds, blood pressure 90/64, abdominal girth 27½ inches. There was ascites, and the spleen was enlarged 3 inches below the costal margin and was firm to the feel. There was moderate amount of fluid in the right pleural cavity. Daily urinary output was 15 ounces.

Investigations—Urine: high coloured, specific gravity 1010, reaction acid, albumin present (+++), casts (hyaline, granular and epithelial), red blood cells, pus cells, amorphous phosphate and ammonium urate crystals present. Blood: total red cells 3,980,000, total white cells 13,000, polymorphonuclears 61.0 per cent, lymphocytes 32.0 per cent, large mononuclears 5.0 per cent, eosinophils 2.0 per cent, haemoglobin 7.5 g per 100 c.c., a fair number of BT schizonts and few amoeboid forms present. Spleen puncture: BT trophozoites and MT crescents present. Blood urea 57.0 mg, non-protein nitrogen 45.6 mg, cholesterol 320.0 mg, and protein 6.4 gm per 100 c.c. Stool, normal. W.R., negative. Pleural fluid: albumin 0.25 per cent, Rivalta's test negative, total cells 142 per c.mm., polymorphonuclears 13.0 per cent, lymphocytes 87.0 per cent. Screening of the chest showed presence of fluid in right pleural space.

Progress and treatment—For one week he was given salt-free diet, limited amount of fluid, alkaline diuretic mixture 6 drams thrice daily. After a week's treatment there was no improvement at all. His urinary output and weight remained the same. Urine: specific gravity 1015, reaction acid, albumin present (+++), casts (hyaline, granular and epithelial), red blood cells, pus cells and ammonium urate crystals present. Blood urea 57.0 mg, non-protein nitrogen 45.6 mg per 100 c.c. Then he was given 10 tablets of mepacrine within 4 days. But the patient's condition became worse. Oedema of face and legs increased. Weight became 3 stones and 9 pounds, abdominal girth increased to 28 inches, and daily urinary output became 12 ounces. Urine: specific gravity 1018, reaction acid, albumin present (++++), casts (hyaline, granular and epithelial), red cells (in large number) and pus cells present. Blood showed no parasites. Then he was treated for one week with quinine by oral as well as intravenous routes (3, 4 and 5 grains of quinine bishydrochloride injected on three consecutive days and 15 grains of quinine sulph by mouth every day). After a week's treatment the patient showed definite improvement. Oedema became much less and it was particularly evident on the penis and the scrotum which were massively oedematous before quinine was started. Weight became 3 stones and 4 pounds, abdominal girth went down to 26 inches, daily urinary output increased to 21 ounces. Urine: specific gravity 1012, reaction alkaline, albumin present (++) , casts (hyaline and granular), red blood cells and pus cells present in very small number. During the next week he was treated with iron. During this period the improvement was maintained. After another

week he was again treated with quinine sulph 12 grains a day by mouth for 7 days. The patient, after the completion of the treatment, showed marked improvement as evidenced by the following. Very slight oedema on legs, no ascites, no hydrothorax, spleen just palpable, daily urinary output 20 ounces, and weight 2 stones and 13 pounds. Urine specific gravity 1005, reaction alkaline, albumin present (+), no casts, a few pus cells and occasional red blood cells present. Blood urea 45.0 mg, non-protein nitrogen 40.5 mg, cholesterol 400 mg per 100 c.c. Blood total red blood cells 3,450,000, total white cells 18,350, polymorphonuclears 60.0 per cent, lymphocytes 37.0 per cent, large mononuclears 3.0 per cent, eosinophils 1.0 per cent, haemoglobin 12.5 gm per 100 c.c., no malarial parasites present.

DISCUSSION

The patient was suffering from glomerulotubular nephritis as evidenced by the urinalysis. The etiology of nephritis was malarial infection as corroborated by the demonstration of parasites in the peripheral blood as well as in the spleen puncture material. The parasites responsible were both *P. vivax* and *P. falciparum*. Heilig's opinion that in such cases *P. vivax* alone was the infecting parasite seems called to question. One would in this connection quote the editorial comment of *Indian M. Gaz.* (1942) — 'Professor Heilig believes that *P. vivax* was the responsible parasite in his cases, but as in most malarious countries mixed infections are the rule this conclusion must be examined more carefully'. Absence of any response to the routine diuretics but dramatically to quinine in such cases was shown by Heilig (1941, 1942) and Laha (1945). This was confirmed in the present case. In spite of the marked clinical improvement albuminuria did not clear off completely which meant that the damage of the kidneys was permanent. Mepacrine therapy failed to produce any improvement. As a matter of fact the patient's condition worsened after mepacrine administration as demonstrated by clinical and laboratory examinations. Failure of mepacrine therapy may throw some light on the pharmacological aspect of quinine in such cases. One could say that quinine does not act by destroying the parasites and thereby checking the inflammatory process. Because, if it did so then the patient should have responded to mepacrine as well. But this is a purely negative conception based upon the absence of any improvement to mepacrine therapy.

The persistence of slight oedema of legs could be explained by the persistence of albuminuria. An attempt was made to treat the patient with high protein diet but it could not be possible as he was a rigid vegetarian. The explanation regarding the increase of blood cholesterol in spite of the clinical improvement remains obscure.

SUMMARY

A case of malarial nephritis has been described with a review of literature. Trial to mepacrine was a failure.

(Continued on page 43)

CLIMATE AND TUBERCULOSIS

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L. S. T. Burrell while discussing the subject of climate under Pulmonary Tuberculosis wrote the following in the Medical Annual of 1936 —

'Evans believes that climate is of secondary importance in the treatment of tuberculosis, although it used to be regarded, and still is by most of the general public, as one of the essential factors. Now it is becoming more and more recognised that rest is the essence of treatment, that provided the patient has his rest and exercise regulated by a physician of experience, the actual site of sanatorium or the climate in which he is being treated is of minor importance. He states that the treatment in unfavourable climates near the large Eastern centres of population in America can and is being successfully carried out.

'It is, however, a matter of the first importance to make the patient as happy as possible, or at least to try and remove all unnecessary restrictions which make life irksome for him, and so the psychological effect of the climate should be considered. If a patient wants to go to a certain place and has confidence that he will improve there, it is usually wise to send him, and similarly it is a mistake to send him to a place that he dislikes. For example, a patient who is pining to go to Switzerland will very likely improve rapidly if sent there, but one who dislikes the altitudes and has no confidence that crisp dry air is beneficial is better treated elsewhere. For certain advanced and very acute cases the altitudes are actually harmful, and it often happens that patients arriving at such places as Davos or Arosa have to be sent to a lower altitude. The value of the high Alps is partly due to the reduced pressure of oxygen and partly to the excess of ultra-violet light. These conditions produce a rise in serum calcium and stimulate the blood forming tissues.'

Gauvain (1930) thinks that sun treatment is not so important as alterations of heat, cold, light and shade. A change from heat wave to a week or so of dull or wet weather is beneficial for tuberculosis patients, he therefore, regards the English climate as good.

Young (1934) quotes Ellsworth Huntington — 'The climate of England comes nearer to the ideal than almost any other place'. He too stresses the importance of the variability.

The great variation in the death rate from tuberculosis in different countries in Europe suggests that climate can play but a small part. In 1926 it was as follows per 10,000 of the population (*Tubercle*, 1931)

| | | | |
|---------|-----|-----------------|-----|
| Hungary | 247 | Switzerland | 145 |
| France | 209 | Germany | 97 |
| Spain | 151 | England & Wales | 94 |
| Italy | 154 | Holland | 87 |

And yet people will leave England and Holland flock to Switzerland or one of the Southern countries.

NEED FOR DISCRIMINATION

The perusal of the above authoritative statements would make one believe that climate is of no importance

in the treatment of tuberculosis. Even then we cannot disregard the fact that certain tubercular patients show marvellous improvement and gradually progress towards recovery, when sent to a properly selected *climatic sanatorium*. I purposely mention climatic sanatorium, because in such an institution the patient is benefited not only by the climate of the locality but also by rest, open air life, good food, graduated exercise under supervision of an expert doctor and the strict routine of the sanatorium life. The mistake is often made by sending patients in an advanced stage of tuberculosis for change of climate under supervision of his relatives. The result in most of these cases is far from satisfactory. It has to be impressed on the lay public as well as on the general practitioners that the change of climate alone cannot cure tuberculosis. It may help the recovery of the patient, provided the other cardinal factors for the cure of tuberculosis like rest, good food and adequate medical help and nursing facilities are available.

FACTORS CONCERNED IN CHANGE OF CLIMATE

Very often a narrow view is taken regarding change of climate, as if, the only difference that one has to reckon with is the pure atmosphere. When a patient goes from one place to another the following changes take place in his environments —

(1) The *air* he breathes is different. The difference may be (a) in its temperature, (b) in its relative humidity, (c) in its state of purity *i.e.*, presence or absence of smoke, dust particles, bacteria, fungi etc. floating in the air which have been collectively named as climatic allergens by Storm Van Leewuen, (d) in the velocity of the air, (e) in its composition *e.g.*, presence of ozone, iodine near sea side, (f) in its state of density and pressure *e.g.*, air in mountains is rarefied and its pressure gradually diminishes the higher we ascend.

(2) The *water* that he drinks may have different properties according to the state of its purity and amount of dissolved substances, which depends on the constituents of the soil. Thus the water of a certain place may be rich or poor in calcium, magnesium or iron or sulphates, chlorides, carbonates etc. In certain hill stations the water may contain much suspended impurities or dissolved organic substances derived from decomposing vegetable matter and thus give rise to hill diarrhoea. In other places where the water contains iron or excess of calcium it may have a constipating effect. As certain persons are habitually constipated while others have a tendency to looseness, so the properties of the water have to be taken into consideration in sending a patient for change of climate.

(3) The *food materials* available in a locality are also responsible for affecting the health of a patient. It is well known that the mineral content of vegetables vary with the chemical composition of the soil. Besides, in a place with a plenty of supply of cheap but good food materials like milk, butter, eggs, fish, fresh vegetables and fruits, the patient has a choice of a variety of foodstuffs and can avoid monotony in diet. It is needless to mention that adequate nourishing diet suited to the individual taste and digestive capacity

of the patient is very important in arresting the progress of tubercular diseases.

(4) The quality of *sun-light* that the patient enjoys may be also quite different. For instance, it is a well known fact that mountainous countries receive more intense solar radiation than places situated in the plains. Smoke, mist and dust particles absorb much of the ultra-violet rays of the sun. Naturally, the sunlight in the high altitudes, where the atmosphere is pure is richer in ultra-violet rays than that in the plains. The ultra-violet rays have strong bactericidal power and they destroy most of the germs that may be floating in the atmosphere. Hence secondary infection of open tuberculous lesions is less likely to happen in the hills than in the plains. Exposure of the body to the direct sun's rays *i.e.* heliotherapy, in certain tubercular affections *e.g.*, of bones, joints, glands, peritoneum etc. can be better carried out in the mountains than in the plains, firstly because the circulating air in the mountains being cooler than that in the plains the patient does not feel exhausted on account of the heat and secondly the sunlight being richer in ultra-violet rays exerts a more beneficial action by producing vitamin D in the skin and giving rise to increase of calcium in the blood and favouring calcification of tubercular foci.

BENEFICIAL FACTORS IN CLIMATE

Many wrong notions are held regarding the beneficial factors concerned in open air treatment of tuberculosis. Too much stress has been laid in the past on the chemical composition of the air. But Prof Leonard Hill has, however, conclusively demonstrated that the beneficial effect of open air treatment is mainly due to physical factors like temperature, humidity and velocity of the air. The sense of coolness of the body surface produced by circulating air stimulates the metabolic activity of the whole organism and maintains the tone of the nervous system, specially of the heat regulating centre of the brain.

Increased humidity of the air produces discomfort and perspiration, if the temperature be elevated above 75°F or in some cases above 80°F. Again humid cool air below 70°F is apt to produce chilling of the body surface. This will be easily borne out by the common experience that one can stand much better dry cold than moist cold. Moist heat not only produces discomfort and perspiration and leads to augmentation of fever in febrile tubercular patients but also increases the risks of secondary invasion. The bacteria present in the dust and air of the plains acquire, so to speak, a greater virulence due to their more favourable chances of growth, on account of the heat and the humidity *e.g.*, during the months of August and September *i.e.*, just after the monsoons.

In this connection it is interesting to note what Sir Leonard Rogers (1936) says regarding the incidence of tuberculosis and climate. He found that the incidence was highest in those districts where there was most rain. Absolute humidity which is a measure of combined humidity and temperature, is important, and when this is high the tuberculosis incidence is also high. Those districts which are protected from the

full force of the monsoons have a comparatively low tuberculosis incidence'

From the consideration of the above facts it will be evident that the three essential factors of a good climate are (1) coolness (2) dryness (3) purity of the atmosphere (i.e. absence of dust, smoke, mist etc.)

How Cold Affects Tubercular Patients—Cold climate has the following effects on tubercular patients—

(1) If they were febrile before, in spite of rest in bed, their temperature goes down very quickly and has a tendency to become normal. This means that the activity of the tubercular foci becomes less in a cold climate. Friedberger and Seidenberg (1927) have shown that symptoms of acute or chronic anaphylaxis in guinea-pigs were not observed, if the animals receiving the injections of foreign protein were kept in cold free air at temperatures which seldom exceeded 6°C. Though of course the biochemical processes concerned in anaphylaxis, namely, the reaction between antigen and antibody leading to formation of anaphylotoxin, are not the same as those responsible for fever in tuberculosis, still there is some similarity between the two. For according to Fishberg (1932) 'the fever is engendered mainly by the increased production of heat—the result of complex biochemical processes having their origin in the struggle of the organism with the bacilli, the body summoning its defensive forces against the toxins produced by the metabolic processes of the bacilli and decaying tissues which stimulate the heat regulating centre'. From the above considerations it is quite comprehensible how cold climate can lessen febrile reaction of tubercular patients. Of course, this does not mean that a febrile tubercular person on going to a cold climate need not take adequate rest. On the contrary rest in bed is as essential for the fight against tuberculosis in a cold climate as in a hot climate.

(2) The patients sleep better and so naturally have better physical and mental rest.

(3) Their appetite improves and so they can take more nourishment and digest better. Butter, oil, fats and preparations of cod-liver oil are better tolerated in a cold climate than in a hot climate, because on account of the cold the body requires more fuel foods.

(4) The night sweats become less and less as the general symptoms of toxæmia become less marked.

In one word in a cool climate the patient is better able to fight with his disease than in an exhausting hot climate.

Dryness and Purity of Atmosphere—Dry air (relative humidity below 40%) causes irritation of the mucous membrane of nose, throat and larynx, sleeplessness, general irritability, quickness of pulse rate and dryness of the skin. If there be prevalence of wind in a dry place, dust is blown about in the atmosphere and inhalation of such dust-laden dry air often leads to nasal or pharyngeal catarrh or tonsillitis. Chronic bronchitis is aggravated by irritation of dry air. Due to excessive dryness the mucous membrane of the nose becomes too dry to function properly, namely, to humidify and heat the inhaled air. The surface epithelium is destroyed due to dryness and presence of irritating dust particles and this is followed by bacterial and viral infections leading to common cold. It is

needless to add that in all tubercular patients with ulcerative lesions of the lungs, any form of upper respiratory catarrh is very harmful, in as much as it leads to secondary infection and aggravation of broncho-pulmonary inflammatory symptoms. Excessive dryness often leads to nasal bleeding due to cracking of mucous membrane of the nose. This has a very adverse influence on phthisical patients who are mortally afraid of hæmoptysis. Another important effect on the system is produced indirectly through deficiency of C vitamin in the diet on account of vegetables and fruits losing their C vitamin by the drying effects of hot dry climate. As is well known C vitamin deficiency causes bleeding from the gums and similarly it favours injury to nasal capillaries leading to nasal bleeding. One may surmise that prolonged C and K vitamins deficiency in the diet may predispose the patients to hæmoptysis.

Damp air has a soothing effect on the nervous system and tends to lessen blood circulation and encourages restful sleep. This is of advantage for tubercular patients. But excessively damp mist-laden air is however prejudicial to health. It favours respiratory catarrh and augments the expectoration of bronchitic and phthisical patients with ulcerative lesions. Damp air has a bad effect on patients suffering from sinusitis. This is a very common trouble in tubercular patients and consequently damp air tends to augment upper respiratory catarrh.

It is needless to add that smoke-laden atmosphere is very harmful for pulmonary tuberculosis patients. So from the point of view of tubercular patients pure cool air which is moderately humid (about 50 to 60 per cent relative humidity) and free from dust and smoke is favourable for the healing of lung lesions.

Wind Movements—Very strong wind is harmful for tubercular patients. In a dry place strong winds blow about dust and lead to upper respiratory infections. In a moist place strong winds cause excessive chilling of the body surface which may be too uncomfortable for the patient to lead an open air life. To what extent wind movements cause chilling has been recently investigated by the Kata-thermometer in which there are 2 bulbs filled with coloured spirit, one is dry, the other bulb which is covered with wet lisle thread cap is the wet Kata. According to Hill, still air at 89°F has a cooling power, as determined by wet Kata, to the extent of 3.3. At the same atmospheric condition a wind of 9 metres per second velocity, has a cooling power, represented by the figure 15. For tubercular patients at rest a dry Kata not less than 6 and a wet Kata not less than 18 is comfortable. Moderate or gentle wind stimulates the appetite and body metabolism in general. This is one of the reasons why near the sea side where there is a constant breeze there is improvement in the health. In a mountain resort where the temperature is naturally cool, strong or even moderate wind movements produce a disagreeable effect on all persons. In such a place for the location of a sanatorium a wind protected site is therefore absolutely desirable.

There is a current belief that strong north-western winds accompanying a thunder storm common during

summer in India, provoke haemoptysis in phthisical patients. There is no satisfactory explanation for this phenomenon. I have heard experienced phthisiologists, attached to Alpine sanatoria, declare that after a thunderstorm at night they have found several cases of haemoptysis next morning. The plausible explanation of depression of barometric pressure, favouring rupture of small aneurysmal sacs on the wall of blood vessels near a lung cavity does not seem to explain the occurrence of haemoptysis, because when a tubercular patient is sent from the plains to a hill sanatorium situated, say at an altitude of 5000 ft, he experiences much greater depression of barometric pressure than usually occurs during a thunderstorm. In nervous patients a violent thunderstorm produces mental excitement, agitation and insomnia and leads to increase in blood pressure and this combined with sudden diminution of atmospheric tension may be the cause of the rupture of the blood vessels in phthisical patients with ulcerative or cavernous lesions in the lungs. In India, where the people are much more accustomed to thunderstorms and strong gales than in Europe, such nervous excitement is seldom noticed and the experience of the doctors of Indian sanatoria and hospitals bear out that the norwester gales common during April do not have any definite direct relationship with the incidence of haemoptysis in patients. Whether the rain-bearing winds which are prevalent during monsoons i.e. during July and August have any influence on haemoptysis has not yet been adequately investigated in India.

Absence of wind or sultriness of the atmosphere predisposes to haemoptysis. This fact has been communicated to me by my friend Dr A. C. Guha of S. B. Dey Sanatorium, Kurseong from his personal observations. The reason for the same is, however, not known at present.

Gordon in England had found a low tuberculosis incidence in those parts of Devonshire which were protected from rain-bearing winds. He concludes that those predisposed towards tuberculosis should seek a dry, sunny, cool place with low rainfall and little wind, and protection from the directions from which the main rain comes.

MORTALITY STATISTICS ARE MISLEADING

One cannot judge the beneficial effects of a climate from the mortality statistics of a country because of the following reasons—

1. In the same country various types of climate are met with.

2. The general economic condition of the people, their racial susceptibility have much influence on tuberculosis death rate, for instance, it is well known that people of the Latin race succumb more easily to tuberculosis than Anglo-Saxons or Teutons. In our country, hill people, who live away from civilised society, fall easy victims to tuberculosis because they have not developed the immunity resulting from sub-minimal infections and as such when they are infected, they develop the so-called childhood type of the disease

which usually ends fatally, unless properly treated in the early stages.

3. The flocking of large number of tuberculosis cases from all parts of the world to certain climatic resorts, situated in Switzerland and France may partially explain the high T.B. mortality in those countries. In our country also many moribund or unsuitable cases are sent up to hill sanatoria where they should not have been sent at all. The fatal termination of such cases should not be cited as an evidence of failure of good climate as a factor in arresting the disease. On the contrary, it should be brought home to every practitioner that they should use utmost discretion in selecting the type of cases to be sent to the hills, and the earlier the cases are sent, the better are the chances of arrest of disease.

CONCLUDING REMARKS

There is a growing school of physicians who believe that climate is practically of no importance in the treatment of tuberculosis and they prefer to treat all tubercular patients in their own home climate, as Burrell and others have advocated English climate as opposed to continental climatic resorts. I have discussed the subject of climate in its broadest sense and pointed out the beneficial factors of climate and its effect on tubercular patients. It is true that with the frequent use of modern collapse therapy, it is possible to arrest the progress of tubercular diseases of lungs even under adverse climatic conditions of excessive heat or humidity with sultriness of weather which one frequently comes across in the plains of India. But there are still a large number of cases in whom stabilisation of the patient cannot be achieved inspite of adequate rest and all the modern methods of treatment. In such cases a change of climate to a cool and moderately humid climate in the hills may just give the necessary stimulus to the body's defensive mechanism, so that the disease is arrested without any further trouble. Climate is thus one of the factors which facilitates the healing of tubercular diseases. Just as to tide over the critical condition of the heart, say in a case of pneumonia, a doctor may have to resort to injection of cardiac stimulants, so in cases of tuberculosis, when the fight is uneven between the invading germs and the body's defensive mechanism, a change to a suitable climatic sanatorium may just help the patient to go through the adverse months of his fight and come out successfully with complete arrest of his disease. In early cases it is possible to completely arrest the disease without resort to any of the methods of collapse therapy by rest and sanatorium regime only in a climatic resort and such a cure is much more desirable from the point of view of the patient and doctor alike.

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ON THE SIGNIFICANCE OF USING DECOMPLEMENTISED SERUM IN BLOOD MATCHING

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Blood matching is of primary importance for a blood transfusion. A wrongly matched blood may not only be the source of various alarming reactions following a transfusion, but the patient may be actually killed by such an incompatible transfusion.

In looking for the compatibility of the blood we do what is called 'direct matching'. We mix a suspension of the donor's red blood corpuscles in normal saline with a sample of blood serum obtained from the patient and see if clumping occurs or not.

The basis of this is the agglutinin content of the red blood corpuscles and the agglutinin content of the serum, clumping occurring when the corresponding agglutinin and its agglutinin come together.

The danger lies in declaring a non-compatible blood as suitable, on account of missing the clumping, in spite of the homologous agglutinin and agglutinin

being present in the red blood corpuscles of the donor and the serum of the recipient.

This is apt to occur if the agglutinin-agglutinin reaction is very weak and takes a long time to develop.

Majority of the clumping or non-clumping are so obvious and clear cut to the naked eye, that one is very apt to feel so secure about his judgment, as not to use the microscope as a routine, before declaring the reaction as compatible. Herein lies the danger of the very weak agglutination.

Hans Sachs (1942) of the Trinity College, Dublin, has drawn attention to the presence of some factor or factors in fresh serum which inhibits antigen-antibody reaction. Labile serum proteins present in fresh sera are held responsible for this inhibitory role. They are said to be stabilised by heating at 55°C for half an hour and making them inert and thus removing their inhibitory action.

In matching of blood the serum of the patient used is practically always a freshly obtained one. So, the possibility of the labile proteins inhibiting the agglutination reaction is to be kept in mind. To get rid of this inhibitory action, if possible, should be the aim of all doing the blood matching.

TABLE SHOWING RESULTS OF EXPERIMENTS

| Blood Group of the person whose serum is tested | Agglutinin content of serum | Tested with r b c of Group | Serum dilutions | | | | | | | | | |
|--|-----------------------------------|----------------------------------|-----------------|-----|-----|-----|------|------|------|-------|-------|----------|
| | | | Undil | 1 2 | 1 4 | 1 8 | 1 16 | 1 32 | 1 64 | 1 128 | 1 256 | |
| A | Beta | B | + | (+) | W | — | — | — | — | — | — | Unheated |
| | | | V | V | + | W | — | — | — | — | — | Heated |
| O | Alpha & Beta | B | + | + | + | (+) | — | — | — | — | — | Unheated |
| | | | V | ++ | ++ | + | (+) | — | — | — | — | Heated |
| B | Alpha | A | ++ | + | + | (+) | — | — | — | — | — | Unheated |
| | | | V | ++ | + | + | (+) | — | — | — | — | Heated |
| O | Alpha & Beta | B | ++ | ++ | + | + | (+) | — | — | — | — | Unheated |
| | | | C | V | V | ++ | + | W | — | — | — | Heated |
| B | Alpha | A | V | ++ | + | + | (+) | — | — | — | — | Unheated |
| | | | C | V | V | + | + | — | — | — | — | Heated |
| O | Alpha & Beta | A | C | V | + | + | W | W | — | — | — | Unheated |
| | | | C | C | V | + | + | (+) | — | — | — | Heated |
| O | Alpha & Beta | B | C | V | V | ++ | + | (+) | — | — | — | Unheated |
| | | | C | C | C | V | + | + | W | — | — | Heated |

C (complete) = Clumps of cells in clear surrounding fluid visible to the naked eye.

V (visual) = A somewhat weaker reaction with clumps distinctly visible to the naked eye, although the surrounding fluid is not clear.

++ = Very big clumps under the microscope.

(+) = Less than +, clumps of 8-12 cells.

W (weak) = A definite but weak reaction in which there is a uniform distribution of very small clumps of about 4-6 cells.

— = No clumping i.e., discrete r.b.c. under the microscope.

+ = Not quite such big clumps.

A.B.—System of scoring is on the lines advocated by Taylor *et al* *J Path & Bact* January, 1942.

EXPERIMENTAL

To what extent the heating of fresh serum can intensify the reaction, comparative observations were made between the agglutinations given by fresh unheated serum with the reactions obtained with same serum heated

A suspension of a red blood corpuscle containing the corresponding agglutinin was made for each of the sera tested. So far 52 cases have been investigated. The source of the serum tested was confined to those cases where the freshness of the sera was guaranteed. Only the samples of blood collected within 24 hours were used.

To note the differences in the intensity of agglutination and in order to be able to make smaller differences obvious, it was necessary to obtain the serum in different concentrations. For this a series of increasing dilutions was obtained separately for this heated and the unheated serum. Each of these dilutions was tested with the same suspension of red blood corpuscles. Test tube technique was adopted.

It was noted that barring a few cases *i.e.* only 4 out of 52, a distinct difference was observed between the agglutination given by the fresh heated serum in comparison with the same when unheated.

The differences observed showed an increased intensity of agglutination in the fresh heated serum in contrast to the same when unheated. This has been manifested not only in the sera with low titre of its agglutinin, but also in those possessing a greater concentration of the same.

In some of the cases, 6 out of 52, it was found that the clumping given by the fresh unheated sera was so weak that clumping could only be detected when seen under the microscope, even with undiluted sera or the next dilution *i.e.* 1 in 2. These were the cases with low agglutinin titre up to 8.

But a marked change occurred when the suspension of the red blood corpuscles was tested with the same fresh serum, but this time after heating at 55°C for half an hour, what was only microscopical clumping with the unheated serum, became strong enough to be obvious to the naked eye when heated serum is used.

In the cases of sera with greater concentration of agglutinins (titre 16-32 or beyond), the intensity of agglutination was strong enough in the undiluted fresh unheated serum to be obvious on naked-eye examination. The effect of heating in intensifying the agglutination, however, was also manifested in these cases, specially towards the higher dilutions.

HAEMOLYSIS OCCURRING IN CERTAIN CASES

In a certain number of cases (9 out of 52) another phenomenon was observed in addition. This was haemolysis or laking of the red blood corpuscles. It was interesting to note that this haemolysis occurred only with the fresh unheated serum. No such haemolysis was observed when the same serum was used after heating at 55°C for half an hour. This haemolysis of the red blood corpuscles with the fresh unheated serum was confined either to the undiluted or at the most the dilution of 1 in 2, the concentration of serum usually used for matching.

Unless one keeps this fact in view, the haemolysis can create confusion in the mind of the worker. He will find it difficult to say if the red blood corpuscles and the serum are compatible or not, as he neither sees red blood corpuscles nor the clumps under the microscope. The absence of clumps under the circumstances may lead one to a wrong conclusion of compatibility, unless he is able to appreciate not only the absence of clumps, but absence of discrete red blood corpuscles as well. This is naturally of great practical significance in actual blood matching and heating of serum at 55°C for half an hour which removes this factor is a definite improvement.

Greval *et al* (1943) mentions of two iso-haemolysins, *i.e.* anti-bodies in the serum that will bring about haemolysis of the particular group red blood corpuscles one *b* in a person belonging to group 'O' and another *a* also in an 'O' group person. He mentions of these iso-haemolysins being inactivated by heat.

Whether the haemolysis occurring with fresh unheated serum in my cases were due to such iso-haemolysins in the sera as described by Greval (*loc cit*) or due to some other factor, I am not yet in a position to say. The cases showing haemolysis included sera not only from persons belonging to group 'O' but also from persons of 'A' and 'B' groups.

SALT CONCENTRATION IN BLOOD MATCHING

The salts (electrolytes) are necessary for an agglutination reaction between the antigen and the antibody, in our case the agglutinin and the agglutinin. The precise way as to how the electrolytes work has not yet been fully elucidated. It is said that it acts by reducing the electrical potential between the cells, thus minimising the mutually repellent influence of the similar electrical charges carried by the cells.

Sachs (*loc cit*) has suggested using of higher concentration of salts in preparing the red blood corpuscles suspension (instead of the usual normal saline *i.e.* 0.85 per cent NaCl) to intensify the agglutination. Use of 2-3 per cent NaCl solution has been advocated.

A few of my cases were put up with red blood corpuscles suspended in 2 per cent NaCl solution as well as the normal saline and both such suspensions were tested against fresh heated and unheated serum. The intensities of agglutination showed that increase in the salt concentration to 2 per cent can further intensify the reaction over and above that obtained by heating the serum at 55°C for half an hour.

CONCLUSIONS

1 In doing direct matching for selection of compatible donors, it is an advantage to heat the serum at 55°C for half an hour, as this intensifies the agglutination by stabilising the labile proteins present in fresh serum which inhibit the reaction.

2 The importance of this inhibitory factor in fresh serum lies in that its suppressing effect may vitiate agglutination reaction during direct matching between incompatible serum and red blood corpuscles. This is particularly liable to happen with weak sera.

(Continued at foot of col 2, page 57)

SPECIAL ARTICLE

HEALTH SERVICES OF THE SOVIET UNION*

R S SAXTON, MAJOR, R.A.M.C.

INTRODUCTION

The Social revolution in Russia made possible an enormous economic development, which in turn made possible the most comprehensive social services in the world. Without the economic foundation these social services could not have been achieved, and without the social services the tempo of economic development could not have been maintained.

PRINCIPLES

Human beings are recognised as the most important assets of the U.S.S.R., and to maintain them in the best possible health is recognised as a matter of first importance and as a national responsibility.

BASIS

There are many factors which contribute to and form a firm basis for the Health Services of the U.S.S.R. Some of the more important ones are as follows—

(1) *Trained personnel*—Instead of the previous total of 14,000 doctors in the whole country, about twice that number now qualify annually, and the total in the country is of the order of 2,00,000. The total number of doctors in relation to the population has in fact altered in the course of 30 years from a condition similar to that in India to a condition similar to that prevailing in England.

(2) *Premises*—The increase in medical personnel has been accompanied by a great increase in hospitals and in the development of many new institutions in particular polyclinics and rural medical centres, and in the turning over to use as sanatoria and rest homes, of many royal palaces etc.

(3) *Equipment*—Instead of having to import all but the simplest drugs and apparatus, now there is practically nothing from X-ray apparatus to sulphadiazine that is not made in the U.S.S.R. These products are supplied to individuals and organisations by some 10,000 state pharmacies, and drugs only at a further 20,000 retail shops in the country-side. There is no patent medicine trade.

(4) *Food*—Russia used to be the 'granary of Europe', but after the first 5-year plan less and less grain had to be exported, as indigenous industries supplied many of the products previously bought abroad. At the same time greatly increased production was obtained by collective farming and greater variety in food production was introduced. Thus the diet of the people has been enriched in quality and quantity to the great benefit of their nutrition.

(5) *Social security*—The certainty that undergoing treatment will not result in disastrous financial loss and unemployment, and to know that no question of cost

will prevent the best treatment being given, remove many of the anxieties which may prevent people from seeking medical advice in good time, and in persevering to the completion of all treatment and convalescence that may be required.

(6) *Leisure*—Two to four weeks holiday per annum on full pay was the established rule, and the shortest working day in the world prevailed, in the U.S.S.R. before the war.

(7) *Education*—The abolition of illiteracy, the emancipation of women, the teaching of ideas of cleanliness, fresh air, exercise, proper diet, disease prevention, all these accompanied the unparalleled extension of general education to 34,000,000 pupils.

THE SCOPE OF THE HEALTH SERVICES

(1) From the earliest sign of disease to the end of convalescence a complete service is available to the whole population irrespective of financial considerations.

(2) Public health preventive medicine, and curative medicine are closely linked and are often undertaken by the same institution.

(3) Positive improvements in health are facilitated by improved diet in the large-scale public catering for workers, through energetic housing programs, through the provision of proper bathing facilities, the encouragement of sport, etc.

MOTHER AND CHILD

All expectant mothers are encouraged to attend antenatal clinics for general supervision and advice, and in many towns there are 'museums of mother and child' where they may see model layettes, simple toys, cradles, etc., and get advice on feeding, hygiene, or even on legal and financial matters relating to motherhood.

Pregnancy leave on full pay is 5 weeks before birth till 6 weeks after birth, and longer if medically advised. If the mother chooses to return to work, the factory, farm or district will provide a crèche to care for the child in working hours. 1,800,000 babies are regularly cared for by trained staff in these institutions, and some 10,000,000 at harvest time. Mothers get time off from work to feed their babies. In the best crèches, they wash and put on a clean gown for the purpose. The mother can also receive, at small cost, a suitable meal at the crèche.

SCHOOL MEDICAL SERVICES

Every school has a doctor in part-time attendance. His duty is not only to attend the children when sick, but he has a number of other responsibilities.

(1) He advises the school on matters of hygiene, and usually he has to assist him in the execution of his suggestions one pupil elected from each class who is responsible for seeing that the school rooms are well ventilated, the ablutions are satisfactory, that habits liable to spread infections are discouraged, etc.

(2) He usually gives lectures on various medical subjects, including first-aid, and he will answer either

* Read at a meeting of Calcutta Branch of the I.M.A. on September 20, 1945.

privately (if so requested), or publicly in his lectures (if of general interest and importance) questions the pupils may put to him in writing in his 'question box'

(3) He carries out the annual health inspection which is compulsory for all children in the spring, when cases are selected for sanatoria or rest home as may be necessary. In addition schools usually organise holiday camps where pupils may enjoy a healthy outdoor life for a part of their summer holiday

GENERAL PUBLIC SERVICES

Medical attention is usually provided for the public through ambulatoria*, polyclinics† and hospitals in residential areas or in the places of work

Ambulatoria do the work of the general practitioner and polyclinics that of the 'out-patients' of a hospital as we know it. They contain all the usual special departments, and have laboratory, x-ray, physio-therapy and other special facilities. They send out doctors and nurses on domiciliary visits. In the country the corresponding institution is the Rural Medical Centre which can hold a few in-patients at a time, being usually distant from a hospital

Hospitals are closely linked with polyclinics. Big factories often have their own polyclinic, and if not their own hospital, have a number of beds in nearby hospitals reserved for the use of their patients. Factories also may have their own rest homes, sanatoria and maternity homes, all run by the Trades Union. Including maternity beds, there are nearly 1,000,000 hospital beds in the U.S.S.R. The level of treatment in the modern hospitals is up to the best European standards. Examples in the field of surgery are the great advances in the technique of corneal grafting made by Prof. Filatov in Odessa, and some of Prof. Yudin's cases we saw in Moscow in whom a subcutaneous artificial oesophagus had been constructed. The medical staff of hospitals and polyclinics are all salaried, and their salaries varied in 1936 from 600 to 1000 rubles a month, for a 6-hour working day. They were permitted to take on other part-time appointments, and many did so. Nurses lived in their own homes outside the hospitals, and worked regular and reasonable hours

PUBLIC HEALTH

Coupled with the administration of the medical services or the individual there has been a big development in Public Health

A clean piped water supply and water-borne sewage systems have been installed in all towns and many country places. To this may be largely attributed the fact that cholera once a scourge, has now been completely eliminated

Compulsory vaccination of children has similarly eliminated small-pox in that section of the population. Compulsory diphtheria inoculation has greatly reduced the incidence of diphtheria, and it has completely vanished from certain localities. Inoculation with

T.A.B., at one time pursued with great vigour, while proper sewage disposal was being provided, reduced the incidence of enteric diseases very considerably

Anti-malaria stations combine attention to diagnosis and treatment with attacks on the breeding grounds of mosquitoes, including spraying from the air. Malaria-ologists accompanied evacuees going east into parts of the U.S.S.R. where malaria is endemic, and undertook immediate treatment of any case, so reducing the spread of the disease. The drug used is Akkrakhine*, a Soviet preparation

Trachoma has also been dealt with from a public health point of view. Trachoma posts, dispensaries, and research institutes have co-ordinated prevention, treatment and research. The result has been that the spread of the disease, even under war conditions, has been prevented, and that the incidence of the disease and of blindness resulting from it, has been much reduced

The general results in improved public health can perhaps be best appreciated by considering the figures of infant mortality. The figure had been reduced from about 250 per 1000 in Tsarist days to about 90 per 1000 in the late 1930s. It should be noted that these figures include large numbers of people living in remote and previously very backward parts of Asia. The figure in England at the time was about half this number (though probably about double this number for the whole Empire), but the rate of improvement in the two countries indicated that, but for the war, the U.S.S.R. would have caught up with England before 1950. Figures for the incidence of T.B., and of T.B. and general mortality, were in similar proportion to those in England. One interesting point in the comparison of the figures for T.B. incidence and mortality was the relatively steady improvement in the U.S.S.R. before the war. Comparing two ports, for instance, Bristol and Leningrad, it can be shown that during the period 1929-1933 a deterioration took place in Bristol whereas steady improvement continued in Leningrad. Bristol was, of course, adversely affected by the economic slump, but slumps are unknown in the U.S.S.R., and this economic difference is reflected in the changes in T.B. incidence and mortality

MISCELLANEOUS

The enormous variety of types of organisation within the Health Services does not permit of a comprehensive account in one lecture. A few further matters of interest may be briefly mentioned

(1) *Moscow accident service*—Hospitals are designated in each area to receive road accidents and other emergency cases. A team of doctor and ambulance staff is always standing by. They have to be out of the hospital on their way to the accident within 3 minutes of receiving the call. If not, an enquiry is held

(2) *Railway station nurseries*—At important railway junctions where waits may be protracted,

* Ambulatorium—10,000 patients, 14 doctors, dentists, Lab., x-ray
† Polyclinic—100,000 patients, 200 doctors. All specialities

* I. M. Injection, painless. No tinnitus. More slowly excreted than quinine.

nurseries are provided where parents may leave their children in competent hands all day. The children will receive food and attention at small cost and will have plenty of toys and company. Meanwhile the parents can go out and see the town, etc. The nurses are selected partly on account of their linguistic capabilities, so as to be able to deal with children speaking any of the main languages of the U.S.S.R.

(3) *Prostitution*—This profession has practically vanished principally because there is an opportunity for honest work for everyone. To deal with ex-prostitutes prophylactoria were provided in all large towns, and later it was possible to reduce their number to three only in the whole of the U.S.S.R.

These prophylactoria combine training for some useful occupation with treatment for V.D. if present. The women are paid while at the institution, and are found jobs in factories when trained. Some find work in factories difficult, and these are permitted to continue living and working at the prophylactorium at a small salary.

(4) *Venereal disease*—Once diagnosed, treatment of V.D. is compulsory until cure is pronounced. Patients knowing they have the disease, and transmitting it, are liable to severe penalties. This attitude combined with the abolition of prostitution and the high level of general culture achieved, have reduced V.D. to a low level. Syphilis had in fact entirely disappeared from parts of the U.S.S.R. before the German invasion reintroduced it.

(5) *Night sanatoria*—These are institutions where people who are temporarily unfit for home life, and require some health supervision, can spend a few weeks while continuing part-time or full-time work. Examples are cases of open T.B. liable to infect their families, or skin disease such as psoriasis. Any necessary treatment can be given in the evening, and the patient is obliged to spend a quiet evening, take some suitable food, and go to bed in good time.

(6) *Flying squads*—These are medical units comprising consultants and specialists, with the necessary assistants and apparatus, who fly on a regular schedule to distant rural centres to advise and treat patients selected for their attention by the country practitioners in the intervening period.

(7) *Research*—In each field of research there is a Central Research Institute which plans the research work in that particular field for all research institutes in the country. There are over 100 large research institutes covering medical subjects. Publications dealing with their work are printed in 45 monthly journals. There are two general medical journals and the Commissariat of Health publishes its own daily paper.

(8) *Medical education*—In the 82 higher medical schools the course is now being increased from 5 to 6 years. After the first 4 years a partial specialisation takes place according to the type of work the student prefers. The three types of work are—curative-medical, sanitary-hygienic, and pediatric. Of the 25,000 to 30,000 annual intake of students, about 75% are women.

Education, however, does not end with qualification for a refresher course is compulsory every 3 years. There are also associations of doctors in the various specialties who arrange lectures, demonstrations, etc. in all large centres.

WAR DEVELOPMENTS

The public service already existing made a transition to a War service relatively simple except that so many more doctors were rapidly required and so much more surgery had to be done. However all difficulties were overcome as evidenced by the fact that over 7% of the wounded returned to military duties.

Some points of interest are—

(1) The number of medical students was greatly increased, and 100,000 doctors were trained in 3 years. Considerable numbers of specialists with a certain knowledge of surgery were given a course in general surgery, pending the training of a sufficient number of newly qualified surgeons.

(2) Specialist hospitals were developed for all kinds of surgical conditions, and great successes were achieved in these hospitals. For instance a doctor who had lost both arms, one above and one below the elbow, was enabled to look after himself, to type, and to act as Public Health Inspector.

(3) Advances in blood transfusion. Much pioneer work in transfusion had already been accomplished in the U.S.S.R. before the war. For instance, the use of cadaver blood whose collection we observed in Moscow.

During the war, as in other allied countries, whole blood and dried plasma were used on a mass scale, and air supplies were available to advanced forces and to guerrilla units.

A new technique which has been tried with encouraging results, has been arterial transfusion of patients whose condition indicates that a transfusion into a vein would be unlikely to be effective. Such patients are in coma, have an imperceptible pulse, and have practically stopped breathing. 200 c.c. to 300 c.c. of blood at 160 to 200 mm. of mercury pressure is injected into the brachial artery. This closes the aortic valves and forces blood through the coronary arteries, restoring the heart beat sufficiently for a venous transfusion to restore the circulation. This treatment has to be combined with vigorous artificial respiration using an intratracheal tube and a bellows.

CONCLUSION

Organisationally the Soviet Health Services are the best in the world. They rest on the firmest foundation in the world. They suffer from the backwardness of the past, so that they have not, in comparison with some countries, the same proportion of older, more experienced trained men and research workers. This is a matter which will be put right with the passage of time. They suffer still from the past very bad Public Health and terrible poverty. This has left its mark in T.B., infant mortality, etc., but there can be no doubt that a decade or so of peace will enable the U.S.S.R. to lead the world in these respects too.

ADDRESS

PROGRESS OF SURGERY IN THE PROVINCE OF MADRAS*

T S SHASTRY, LT-COL, I M S

As a little boy I happened to see a Hospital Assistant pass a metallic catheter in a struggling adult in my neighbour's house and draw some bloody urine. It was in Kottajam in the Nellore district. This simply horrified me and for many years haunted me.

As a school-boy I used to attend the post-mortem work of the Local Fund Hospital Assistant in Giddalore, Kurnool District, during my summer vacation. This led me to think on the beauties of the structure and functions of the internal organs of the human body.

My father was a patient suffering from a chronic disease and often used to ask me to take up the study of Medicine.

Dr Pattabhi Seetharamiah was the first Andhra M B and C M (1907)—a pioneer for us, Andhras, and furnished a stimulating example.

I saw terrible sight one forenoon in May 1908 while travelling in a bullock cart on the Bunder-Bezwada road. A boy of 10 years fell vertically down on the road in front of me from the top of the tree about 50 feet high. His right arm snapped and two broken pieces shot out.

All these interested me greatly and quickened my desire to join the Medical College. I joined it in July, 1908.

In those times the state of surgery was thus —

Abscesses, carbuncles, superficial tumours, amputations, piles, fissures, fractures, hydroceles, urethral strictures and hernias—whoever did these operations became famous as a great surgeon. Hernia was a serious operation! Removal of elephantoid scrotum was a big undertaking! Removal of cataractous lens was a wonder! Forceps delivery and completing an abortion formed the obstetrical surgery of those days! D & C was the stock-in-trade in gynaecology. Chloroform was the only anæsthetic and was usually administered by compounders. Most of the surgical work was confined to district hospitals, and that was the monopoly of the I M S officers.

Dr Nedungadi was the first Indian to be appointed as a Surgeon in the Madras General Hospital in 1916. That was a landmark indeed! Dr Rangachari was the first Indian Surgeon who performed really first class surgery. No part of the body escaped his knife. His work was good both in quality and quantity.

Among independent practitioners, none had a nursing home with theatre, staff and equipment. Dr T M Nair did some E N T operations but he was not noted as much of a surgeon. Dr Varadapra Naidu did some carbuncles, having worked with Major Smith who resigned from the I M S. Dr Naidu was much in demand in the districts. Generally, people from all parts of the Province resorted to the General Hospital, Madras. Surgery by independent practi-

tioners was an uncommon phenomenon in those days. Thus arose the general notion that no Indian was competent to do decent surgery and that surgery was really a monopoly of the British I M S officer.

In 1912, one evening in May, I met at Blumadole (West Godavari District) the huge, uneducated son of an old-time zemindar who was a famous hunter. He openly told me not to attempt to do surgery as no Indian was ever competent temperamentally to do good surgery, and he went on praising Major Niblock of the Madras General Hospital for his skill for operating an abscess on his leg! This stung me to the quick, and I determined to break this tradition. So, when I got the chance, being surgically inclined by nature, I devoted myself to surgical work. I have ample reason to be gratified with my choice.

The first Great War was a windfall indeed to us Indians who were keen on doing high class surgery. Nearly all the I M S officers were then pulled away to war-duty. Some of the assistant surgeons had to be given charge of district hospitals and teaching jobs in medical colleges and schools. This opportunity proved their intellectual calibre, professional skill and efficiency of hospital management. Many of them proved to be good and great surgeons. Drs Chandrasekhara Mudaliar, Ganpat Rao, Madhava Rao, Halge, Krishnah, Padmanabha Sarma, V Krishna Murthy, Trasi, R Ganapathy Iyer, Nedungadi, Ranga Chari, Lakshmanswami Mudaliar (now Sir) created the surgical era in 1915.

Of all these, the most out-standing surgeon was undoubtedly the late Dr S Ranga Chari who practically lived in his Rolls Royce—an 'ever ready' surgeon, noted for his popularity, quickness, studied reserve, and a spirit of universal sympathy and service—all this success came to him without any foreign training thus showing what a mere M B & C M, could do. In any other country he would have surely been honoured by his Alma Mater with the Honorary Degree of M S or D Sc. But the University of Madras had no imagination, nor a sense of magnanimity or propriety to honour one of its own brilliant alumni. The grateful public, however, installed a full-sized statue of Dr Ranga Chari appropriately at the very entrance to the General Hospital.

Among the independent practitioners in Madras, Dr E V Srinivasan led the way in eye surgery, while Dr T S S Rajan became quite an institution in Trichinopoly. Dr Ramasubramaniam came into fame in Madura quite early in his career. Then came the honorary system. The honorary surgeons made quite a good place for themselves in some hospitals.

Now-a-days surgical skill of high order is available in many towns. Many surgeons have equipped themselves for advanced surgery by training in foreign countries. Nobody now dreams of preferring a British to an Indian surgeon unless it be Dr Somervell of Himalayan fame—but that is not because he is British but because he is a great surgeon, and a humanitarian like the late Rev C F Andrews of blessed memory—in fact he is a citizen of the World.

Thus the old fiction that high class surgery is the monopoly of the British race has been exploded by

* Address delivered at the Surgical Section of the South India Provincial Medical Conference, Trichinopoly, Oct., 1945

Rangachari and others. Today many Europeans—both civil and military, go to Col Pandalar, Dr Mangesha Rao and others.

Starting of nursing homes was the next development. I remember Dr Lakshminpathy's Nursing Home in Madras in 1910. But it was only in name and soon disappeared. Dr Rajan's was really the first nursing home started, maintained and well-equipped, and he has done good work indeed in this line. Then came Dr Rangachari's surgical hospital in Madras. He did most of his first class operative work there, and trained some juniors who, in turn, have opened nursing homes which are all flourishing. Dr Ramasubramaniam started his nursing home in Madura and is doing very good work. Col Pandalar has built a palatial private hospital for surgery—this is easily the best of its kind in our presidency. Dr Sundaravadaniam followed suit in Madras. Captain Sunkavalli has a good one at Bezvada. Dr Raju and his partner have an ambitious nursing home in Palakol, West Godavari. Dr Subramaniam's is a good one at Karakudi with a good record of work. Trichinopoly itself has three other nursing homes—Dr Raghavan's, Dr Kalamagham's and Dr Balu's.

During the Second World War, now happily ended, many young and aspiring surgeons served in the Defence Forces in all the different sectors. They have done splendid work, acquired experience, attained high military rank and very good name. Here I must mention with sincere pleasure my own junior officers, Major V Srinivasan and Lt K. Parthasarthy who served on my staff when I was Commanding the 30th Indian General Hospital in Sudan and in Egypt in 1941 and 1942. The doctors of this Province, I am glad to say, have volunteered in largest numbers, gained a lot of military and surgical experience and international contacts in the various theatres of war, and added to the reputation of the Indian medical profession, of them we are justly proud.

I hope that when these surgeons return to civil side they will be given suitable jobs in the hospitals in the metropolis and other towns. Those who cannot get such jobs ought to be encouraged to open and maintain their own surgical homes with the aid of demobilised nurses—if possible on co-operative basis, with pathological laboratory x-rays, etc.

The large quantities of surgical and medical equipment which the American and British find to be surplus when their military hospitals are closed should be secured by the Government for Government, local fund missionary and other hospitals for the surgical use. Our medical colleges have, of course, better surgical staff than before, and I am sure that they will produce better results if given the required equipment. For obvious reasons I am not detailing the names of their staff. Perhaps the best agency for these surplus stores to be made available to surgeons is the Govt. Medical Stores which may open a Sales Dept.—I have taken this from Dr M. V. Natesan of Madura.

The crying need today is more medical colleges. We have one at Vizag, two at Madras, one at Vellore, and one is under design for Madura. But what about the northern districts? I hope that the policy of

neglect of the Andhra area will not be continued hereafter. I expect Guntur will get a medical college started in July 1946. The required staff, if there is paucity, can be provided for by employing for some time some of the retired surgeons and physicians who are keen and fit to take up this work. Meanwhile the required number of staff must be selected and sent out by the Government to the U. S. A. and trained adequately in all the subjects and employed on suitable terms in these new medical colleges.

In selecting these and other personnel and specially in dealing with the proper employment of war-returned medical and nursing personnel, the Government will be well advised to take the advice of the Indian Medical Association by asking the I.M.A. to send its representatives to the selection committees.

One warning is needed now. Enough experimentation has been done and enough mischief, injury and discontent and even frustration have resulted from the implantation of stern communalism in the matter of admissions into the medical colleges. It is time that a just policy is adopted.

One very good development is the starting and growth of the Association of Surgeons of India in 1938 as a result of the initiative of Col Pandalar. It is flourishing. I hope this and other specialist Associations—which by the way had their birth-place in Madras, (at least, most of them) agree and arrange to hold their sessions jointly with the Indian Medical Association hereafter, and thus make themselves useful to the general body of the profession. In this connection I greatly appreciate the efforts of Dr Jivraj N. Mehta.

Are we fully satisfied with the present state of our surgery? I believe special attention must be given to the surgery of the brain, surgery of the chest, reconstructural surgery and surgical research. Adequate surgical training is necessary. Surgical workshops for artificial limbs etc., and experimental laboratories are to be established for each teaching hospital. Vienna is no longer the Mecca or Kāshi of modern surgery, but the Mayo clinic and others of its kind will give all facilities to us in the U.S.A.

Fellow members, there is a great future and scope for surgery in our country if all the available material be properly utilised and if we serve the people with integrity, sympathy and devotion.

(Continued from page 52)

3 In those with high agglutinin titre, hæmolysis occurred instead of agglutination with undiluted or 1 in 2 dilution of fresh serum. No such hæmolysis but strong clumping was observed when the serum was used after heating at 55°C for half an hour.

4 Increasing the salt concentration to 2 per cent for preparing the red blood corpuscles suspension instead of using normal saline as suggested by Sachs, can further intensify the agglutination. Two per cent saline may be used for direct matching where facilities for heating of the fresh serum at 55°C for half an hour is not available, and even in conjunction with the latter

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JOURNAL OF THE INDIAN MEDICAL ASSOCIATION

CALCUTTA, NOVEMBER, 1945

POSTMORTEM EXAMINATION

We offer no apology to return again to the subject of postmortem examination. Since we discussed¹ it about four years ago, one regrets to notice that the situation has not improved in any way. From the number and nature of articles published from our country, one is forced to arrive at the above conclusion.

From many a platform it has been declared that standard and quality of medical research in our country is not what it should be. There is no denying this fact and if we want to change this position we must face reality. Among a number of other reasons for this quality of research, lack of postmortem examination is undoubtedly one. From a series of figures published by Tribedi² it can be said that during 1930-1939, a period of ten years, postmortems were held in less than 5 per cent of the total deaths in the hospitals. These figures were taken from all teaching institutions in this country. In one hospital attached to a medical school only two postmortems were done against an average of about 2,500 annual deaths¹. How can teaching or scientific medicine progress under these circumstances? What is the cause of this poor record? In every teaching institution there are facilities for autopsy. There are responsible teachers and clinicians attached to or appointed in them. And it is also a fact that everywhere there are no communal organisations which want the unclaimed bodies for disposal. The cropping up of these communal organisations is unfortunate but what is their legal status in respect of unclaimed bodies? Are the teaching institutions bound by law to hand over these dead bodies, without performing a postmortem examination in order to verify the diagnosis or are the medical men in charge reluctant to go through the examination? It is surely not a common sight in our country to find the post-mortem room filled up with clinicians, pathologists and students.

Tribedi (*loc cit*) suggested three courses to increase the number of autopsies *viz*, (a) State legislation (b) Voluntary permit (c) Postmortem examination done on unclaimed bodies. In addition one may suggest the signing of a declaration by the relatives that they will not oppose a postmortem examination, if necessary, before a patient is admitted to any hospital.

Editorial—*J Indian M A*, 11 49, 1941
¹TRIBEDI, B P—*Indian M Gaz*, 76 546, 1941

The idea of voluntary permits appeals to us as being more reasonable than others. For this education of the public is essential. This can only be done by medical men who are at the helm of the profession both in private practice and in the institutions. The question of an operation on the dead in our country is always opposed on delicate sentimental ground. This can be dispelled by propaganda, tact and friendliness. The relation between a patient and a clinician, whether a surgeon, obstetrician or a physician should be more cordial. It cannot be denied that we seldom try to develop this relation in our country in contrast to what one sees in the West. It is amazing how some leaders of lay public are ignorant and sentimental about this question of autopsies. To start with, these men are to be won over. State legislation and others can help the matter in later stages.

As members of the profession, we can hardly put all the blame on the public. There seems to be a camouflaged tendency to avoid autopsies by many of us. One of the reasons for this as pointed out by an editor is³ 'If the medical teacher in India has a weakness, it is dogmatism. He has inherited it from his predecessors, it is encouraged throughout his life by the childlike and unquestioning faith that many students place in their teacher, and it is fostered by the comparative isolation from colleagues of equal or superior mental calibre. Nothing encourages this attitude in a teacher than the thought that, as he is a king pin in his own little circle, he can never prove to be wrong, and nothing could be more salutary for it than the occasional cold douche of a postmortem finding that directly contradicts his clinical diagnosis'. And we think he should take such an education with all the grace in front of his colleagues and students.

The testamentary instructions⁴ of Lord Dawson of Penn throw a new light on this subject. An eminent physician and one time the President of the Royal College of Physicians, he directed that, if conditions of war permitted, a postmortem examination on his own body should be made. He wrote 'I do this because I think the public do not sufficiently realise the importance of postmortem examination being made and the advantages to knowledge and therefore to future generations which will thus accrue. We do not hesitate to have operations on our bodies when we are alive and when circumstances require it. Why, then, should we mind operations (which are done with the same care, the same gentleness, and I may add the same reverence) being done on our bodies when we are dead? Surely this is a rightful service which the dead should give to the living. The benefit of such service to the living is very great.'

³Editorial—*Ibid*, 76 545, 1941
⁴*Lancet*, 2 292, 1945

CURRENT MEDICAL LITERATURE

EFFORT SYNDROME

HILL AND DEWAR (*Lancet*, 2 161, 1945) give in the following lines the summary of their observations

The observations are based on 489 cases of effort syndrome observed in Britain and the Middle East during the present war, the clinical features in 392 of these are reviewed.

At a hospital in the Middle East at which all cases of effort syndrome in the Force were centralised, these cases constituted less than 1% of the 25,000 medical and surgical cases admitted to the hospital in twenty months

The condition is not confined to the young or to men unaccustomed to hard physical exertion, and the onset in a large proportion long antedates entry to the Service.

Serious or protracted illness in childhood, rheumatic and non-rheumatic, predisposes to the development of effort syndrome. In a high proportion of cases the condition is partly at least 'doctor-made'

The relative frequency of various precipitating factors (physical strain, battle experiences, recent infection, domestic worry, etc.) is discussed. Many cases arise without exposure to undue physical or mental strain apparently in individuals of inadequate physique and personality

The treatment by graduated exercises and reassurance carried out at a general hospital in the Middle East in 1941-43 is described. A follow-up investigation carried out by Medical Directorate, GHQ, MEF, showed that nine months after discharge some 80% of 254 cases traced were on full or light duty with their units

GASTROINTESTINAL SYMPTOMS OF HEART DISEASE

MACMILLAN AND OTHERS (*Am Heart J*, 29 530, 1945) write that the condition presented involves a patient who after coronary occlusion, developed heart failure, the primary symptoms of which were nausea and vomiting, and in whom the significant pathologic changes were multiple areas of myocardial fibrosis. As a result of the experiences with this and other similar cases and a review of the literature, the following conclusions are drawn,

1 When nausea and vomiting are dominant symptoms in a case of heart failure, one should consider as possible factors not only drugs, congestion of the abdominal viscera, and disorders of the blood metabolites (such as occur in uraemia), but should also entertain the possibility that progressive myocardial disease may be the cause of the symptoms

2. The mechanism of the nausea and vomiting induced by progressive myocardial disease is believed to be analogous to that caused by digitalis, which has been shown to be due to a reflex arising in the heart itself

3 When coronary thrombosis occurs in a patient with pre-existing narrowing of the smaller coronary arterial branches, a vicious cycle may ensue, the decline in cardiac output and small pulse pressure lead to further coronary insufficiency and progressive myocardial fibrosis which bring about a further decrease in cardiac output and perpetuation of the cycle.

4 In cases of heart failure in which there is a small pulse pressure with a high diastolic pressure, the outlook is poor because of the factors outlined.

THE MEASUREMENT OF THE LUNG-TO-FACE TIME BY AMYL NITRITE

GROSS (*Am Heart J* 30 19 1945) gives in the following lines the summary of his observations —

1 A new method for the measurement of the lung-to-face circulation time, using amyl nitrite as an agent, is outlined. The technique of administration is described, and normal values and their correlations are established. The method is simple, needs no apparatus nor assistants, and can be performed by the examiner alone.

2 The amyl nitrite circulation time (a.c.t.) measures the functional capacity of the left ventricle and is determined essentially by the condition of the pulmonary circulation recognizable by the vital capacity. There exists a tendency of parallelism as much in the absolute value of both factors as especially in their modifications in different conditions of compensation in the same person.

3 The inverse correlation is established between the a.c.t. and the intensity of the warm sensation — more intense heat with shortened circulation time and *vice versa*

4 In conditions of heart failure, the a.c.t. is prolonged, and the intensity of the warm sensation is diminished, but there is no strict parallelism with the clinical features

5 In hyperthyroidism the a.c.t. is shortened and the intensity of the warm sensation is strongly reinforced. Emphysema or bronchial asthma, not complicated by heart failure, are characterized by normal a.c.t. and normal intensity of the warm sensation.

6 Subminimal a.c.t., except for existing intracardial or arteriovenous short circuits, never is observed with cardiac failure, largely prolonged a.c.t. never is observed without heart failure. Medium values of a.c.t. are as compatible in persons of normal circulation as in those with slight failures of it.

7 A differentiation between left or right ventricular failure is not possible, based upon the amyl nitrite measurement.

The test is done as follows

The measurements were made on recumbent patients, after a rest period of ten minutes in a nonbasal condition. The amyl nitrite used in this study was obtained from ampoules which contain 4 minims of the drug and are covered by absorbent material. The time between the commencement of deep inspiration of the vapor of amyl nitrite and the appearance of a well-marked heat sensation in the face was registered by a centesimal chronometer, and represents the lung-to-face time as an expression of the trajectory from the pulmonary capillaries to the capillary bed of the face. Knowledge of certain peculiarities of the physiologic effects of breathing amyl nitrite vapors and adequate preparation of the patient for correct measurement are very important. Information must be given to lessen the possibility of nervous excitement before and during the process, in order to prevent changes in respiration and circulation which may cause significant errors in the measurement. The inhalation must be made through the nose, with the mouth kept closed. In this way the mixture of air with the amyl nitrite vapour is less than it would be if the vapour were inhaled through the mouth. Consequently, before taking the measurement, it is necessary to make several tests of the patient's respiratory behavior. This is done by placing the unopened ampoule directly under his nose and inviting him to take a deep and rapid breath, and then continue to breathe normally and quietly. Only after having made several trials, and being sure of the perfect collaboration of the patient, can the measurement be started. Attention must be drawn to the fact that the ampoule explodes when opened. By thus warning the perturbing effect can be lessened or avoided. Before the process is begun, the patient is asked to breathe several seconds after the first and only deep

PENICILLIN IN VINCENT'S ANGINA

SCHWARTZ (*J.A.M.A.*, 128 704, 1945) writes that penicillin has been found to be of definite value in the treatment of Vincent's angina in 14 cases

The recommended dose is 100,000 units administered intramuscularly in 20,000 unit doses every three hours. In mild cases smaller doses may be required and in unusually severe cases larger doses may be required

PENICILLIN AND SULPHONAMIDES IN ACTINOMYCOSIS

DOBSON AND CUTTING (*J.A.M.A.*, 128 856, 1945) write that sixteen cases of actinomycosis were treated with sulphonamides or penicillin. These cases include 3 pulmonary, 2 abdominal and 11 of the cervicofacial types. Of the 16 cases treated, 7 may be considered cured and 7 arrested, while 2 ended fatally. *In vitro* tests corroborate the clinical impression of varying susceptibility of actinomyces to sulphadiazine and penicillin and of the slightly greater efficacy of sulphadiazine in certain instances. The results in these cases indicate that both penicillin and the sulphonamides are highly effective drugs in the treatment of actinomycosis

CONSERVATIVE TREATMENT OF HUMAN BITE INFECTIONS

HENRY (*Military Surg.*, 97 122, 1945) gives in the following lines a routine procedure in the treatment of all human bites

1 All wounds should be immediately cleansed well with soap and water, followed by gentle debridement.

2 Culture all such wounds (Dark field examinations and ten day anaerobic cultures are diagnostic aids)

3 Tetanus antitoxin or booster shot for human bites, dog, cat, or horse bites

4 Irrigate wound with hydrogen peroxide and Dakin's solution. If these are not available use warm saline.

5 Never suture or repair these wounds regardless of time interval. This is the most common serious error!

6 Leave wound wide open and sprinkle wound with sulphur crystals

7 Hot $MgSO_4$ or boric soaks to extremity once daily for one week.

Check Wassermann-Kahn test on patient and repeat test in one month from time of bite.

9 Avoid amputation in presence of acute infection. Treat conservatively and allow nature to wall off process

10 Check with x-ray for bone involvement at time of inquiry and again later for any complication because of the tendency of these cases to develop slowly into deep undermining wounds and with extension to bone.

11 Splint the extremity between treatments because rest to the part aids in the healing process

12 Penicillin has very slight, if any effect on certain mixed infections. However a ten day treatment with penicillin would be indicated, using 100,000 units each day. Since penicillin is not a specific cure in mixed infections and in order to save any possible man hour loss, it is felt that penicillin should be used in addition to conservative surgical debridement, irrigation and adequate drainage of the anaerobic wound. Both reported patients in this paper, however, only received sulphur crystals locally in wound, but no sulphur or penicillin treatment orally or parenterally

13 All human bite injuries should be well written up in the health record, treated conservatively, and observed carefully for complication. Emphasis should be placed on adequate drainage and an attempt to produce a state of aerobiosis in wound

LABORATORY DIAGNOSIS

DIBLE (*Lancet*, 2 305, 1945) at the summer meeting of the Association of Clinical Pathologists held in London on July 20 and 21, spoke on the pathology of infective hepatitis with special reference to hepatic biopsy. After demonstrating the method of liver puncture by the transpleural route with suction of a small piece of liver substance into the cannula by means of an attached syringe, and describing the alcohol-free fixation to preserve glycogen, and the staining used, he produced a series of slides illustrating the histological appearances in infective hepatitis. The essential features were rarefaction at the centre of the lobule with derangement of columns of cells, the appearance of bizarre forms with swollen cells associated with a cellular infiltration of bile-ducts, and generally a reduction in the width of the lobule. There was, however, good retention of the reticulin arrangement of the liver lobule. Dr Dible demonstrated varying degrees of these changes in various forms of jaundice, including infective jaundice, serum jaundice, and neoarsphenamine jaundice, and suggested that the icterogenic agent was similar and that the toxic pathological changes seen after biopsy were also similar

Major C. E. Van Rooyen described the rapid diagnosis of smallpox by demonstration of elementary bodies from the vesicles. From his experience of several hundred cases in the Middle East he maintained that this was a simple matter and their recognition to a trained observer was reliable. The findings had been proved correct in several cases in which they were doubted because at first the clinical appearances were atypical. A second paper dealt with rickettsial agglutination tests in typhus

Prof. A. D. Gardner read a paper on the laboratory diagnosis of Weil's disease. He had investigated material from 900 suspected cases and had found 150 positive. From his records it was clear that jaundice was not always present and that the non-icteric cases probably had a better prognosis. Case-mortality in the series differed with age, in old people it was 50% but in young people only 5%, the overall mortality being 12%. The agglutination tests had been carried out with formalised suspensions of the leptospira which had been grown in 12% rabbit serum in glass-distilled water. These suspensions had remained stable in his hands for years. Dr Gardner expressed the hope that now that penicillin shows such great promise in the treatment of the disease, attempts at diagnosis will be made earlier in the disease without waiting for jaundice, which sometimes occurred in this series as late as the 8th or 9th day, although it was commonest on the 5th

Squadron-Leader E. M. Darmady's paper on the traumatic uraemia syndrome produced an excellent discussion in which various contributors showed how the syndrome was produced by many factors, including trauma, crush, and severe transfusion reactions, all of which gave similar histological appearances in the kidneys. In this discussion Dr Joan Ross described cases of anuria she had collected from the battle areas

Dr G. R. Osborn dealt with the action of thiouracil on goitres and showed a series of sections demonstrating the main changes. Macroscopically the tumour was often hard, pure white, with no appearance of colloid—very suggestive in appearance of carcinoma. Even microscopically the changes frequently included large cells with hyperchromatic nuclei which also might be mistaken for a carcinoma. Dr Osborn agreed that thiouracil was now the best preoperative means of treatment in the diffuse toxic goitre.

Dr W H Grace described a long series of cases of sudden death in infancy, and explained the difficulties with which even an experienced forensic pathologist might be faced when presented with a 'dead infant.' Asked whether he believed in status lymphaticus he answered that he regarded this as the fifth ace, to be kept up the sleeve for special emergencies.

Papers were also read by Dr M O Skelton, who demonstrated fatal *tracheo bronchial diphtheria* in an infant of five weeks. Dr R. A O Williams spoke on the value of preliminary fluid culture for the isolation of *pyogenic cocci* when a larger yield is desired. Dr A F Sladden spoke on the routine examination for diphtheria, using a tellurite-Loeffler medium which he claimed as a simple and effective substitute for the elaborate media now in use. Dr K. B Rogers described a method of suspending sedimentation tubes in a jar of water at a controlled temperature because of the discrepancies which occurred as a result of temperature variations in this test. A discussion was opened by Dr E N Davey followed by Dr S C. Dyke on the investigation of the allergic state. Some doubt was thrown by some speakers on the value of skin tests in demonstrating sensitivity, but generally it was held that they are of great value in indicating particularly single-allergen sensitivity.

The meeting ended with a paper by Dr H N Stafford on *the corpse, the pathologist, and the coroner*. Expounding the duties and limitations of the pathologist in regard to the coroner he gave his interpretation of the 1887 Coroners Act with the

amending act of 1926. He made it clear that a pathologist may make a post-mortem examination if he considers, or is told, that the death is due to natural causes, and that in any case no 'assault' can be committed on a corpse by so doing. The overriding consideration was that there should be cooperation between the medical men and the coroner, and the coroner must certainly not be obstructed in his duties.

DIPHTHERITIC MYOCARDITIS

BALL (*Am Heart J*, 28 704, 1945) in reporting two cases of diphtheritic myocarditis in adults writes that the electrocardiographic changes observed in the two cases described would indicate that there was severe and extensive myocardial involvement. At no time did these patients have any complaints referable to the cardiovascular system and, at no time, were there any clinical findings to suggest involvement of the heart. In both cases, the changes were reversible and shifting from day to day, suggesting that the changes observed are "toxic" in origin and not due to any structural damage to the heart muscle. In conclusion the author writes that the electrocardiographic changes conform to a type that is easily differentiated from those observed in myocardial infarction due to coronary artery occlusion. The S-T interval is always depressed in diphtheritic myocarditis. The changes are reversible and 'Shifting'. These effects are probably toxic in origin in diphtheritic myocarditis. There was no clinical evidence of heart disease in either case described.

XXII ALL-INDIA MEDICAL CONFERENCE, AMRITSAR

PROGRAMME

22nd December, 1945

| | |
|------------------------|---------------------------|
| 3 p.m. to 4 p.m. | Working Committee Meeting |
| 4 p.m. to 4.30 p.m. | Tea |
| 4.30 p.m. to 6 p.m. | Amalgamation Committee |
| 6 p.m. to 8.30 p.m. | Working Committee Meeting |
| 8.30 p.m. to 9.30 p.m. | Dinner |
| 9.30 p.m. to onward | Working Committee Meeting |

23rd December, 1945

Morning— Working Committee Meeting to be continued if necessary

After Lunch—

| | |
|------------------------|-------------------------|
| 2 p.m. to 4 p.m. | Central Council Meeting |
| 4 p.m. to 4.30 p.m. | Tea |
| 4.30 p.m. to 8.30 p.m. | Central Council Meeting |
| 8.30 p.m. to 9.30 p.m. | Dinner |
| 9.30 p.m. onward | Central Council Meeting |

Morning—

24th December, 1945

| | |
|--------------------------|---|
| 11 a.m. to 11.20 a.m. | Central Council Meeting to be continued if necessary after breakfast (8.30 a.m. to 9 a.m.) upto 10 a.m. |
| 11.20 a.m. to 11.50 a.m. | Inauguration of the Conference |
| | Address of the Chairman of the Reception Committee |
| 11.50 a.m. to 12.50 p.m. | Presidential Address |
| 1.15 p.m. to 2.15 p.m. | Lunch |
| 2.0 p.m. to 3.15 p.m. | Election of the Subjects Committee |
| 3.15 p.m. to 3.30 p.m. | Opening of the Exhibition |
| 3.30 p.m. to 4.30 p.m. | Visit to the Exhibition |
| 4.30 p.m. to 5.30 p.m. | At Home |
| 5.30 p.m. to 8.30 p.m. | Scientific Session (Surgeon) |
| 8.30 p.m. | Dinner |

25th December, 1945

| | |
|------------------------|-----------------------------------|
| 8.30 a.m. to 9.30 a.m. | Breakfast |
| 9.30 a.m. to 1 p.m. | Subjects Committee Meeting |
| 9.30 a.m. to 11 a.m. | Scientific Meeting (Tuberculosis) |
| 11 a.m. to 12.30 p.m. | Pathology |
| 1 p.m. to 2 p.m. | Lunch |
| 2 p.m. to 4 p.m. | Open Session of the Conference |
| 4.30 p.m. to 6.30 p.m. | At Home and Visits to Mills |
| 6.30 p.m. to 8.30 p.m. | Scientific Session (Medicine) |
| 8.30 p.m. to 9.30 p.m. | Dinner |
| 9.30 p.m. | Subjects Committee Meeting |

26th December 1945

| | |
|-------------------------|-------------------------------|
| 8.30 a.m. to 9.30 a.m. | Breakfast |
| 9.30 a.m. to 12.30 p.m. | Scientific Session (Medicine) |
| 12.30 p.m. to 1 p.m. | Visit to Exhibition |
| 1 p.m. to 2 p.m. | Lunch |
| 2 p.m. to 4 p.m. | Open Session |
| 4 p.m. to 8.30 p.m. | At Home and Visits to Mills |
| 8.30 p.m. | Dinner |
| 9.30 p.m. onward | Subjects Committee Meeting |

27th December 1945

| | |
|------------------------|--------------------------|
| 8.30 a.m. to 9.30 a.m. | Breakfast |
| 9.30 a.m. to 11 a.m. | Scientific Session (Eye) |
| 9.30 a.m. to 11 a.m. | Gynaecology |
| 11 a.m. to 12.30 p.m. | Radiology |
| 11 a.m. to 12.30 p.m. | Nose and Throat |
| 12.30 p.m. to 1 p.m. | Visit to Exhibition |
| 1 p.m. to 2 p.m. | Lunch |
| 2 p.m. to 4 p.m. | Open Session |
| 6.30 p.m. to 8 p.m. | Scientific Session |
| 8 p.m. | Dinner |

to show that it occurs. On the other hand, an occasional clinical fact may point to a relapse or an aggravation, or even suggest a late onset. Thus Turner's case (*see* p. 12)—a girl of 10, in whom the deformities were not noticed at birth—did not grow during the five years before the case was recorded. She wore the same frocks as she did when between 4 and 5 years old.

THE CORRELATION OF ACHONDROPLASIA AND OSTEOGENESIS IMPERFECTA.

There are some suggestive points of resemblance between these affections both in their intra-uterine origin and their post-natal course. In achondroplasia the proliferation of the cells at the growing epiphysial region of the cartilage is seriously at fault, and the length-growth of the bone almost

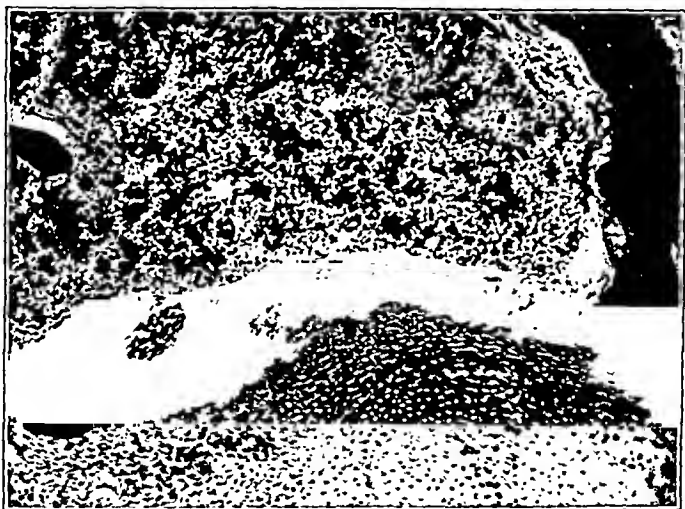


FIG. 21.—The other corner of the epiphysial border shown in *Fig. 16*. Showing a layer of compact bone forming from a thin strand of fibrous tissue which is continuous to the right of the picture with the periosteum. ($\times 85$.)

abolished. In osteogenesis imperfecta the stress falls on the other great bone-forming tissue. The cells formed from the periosteum are not of the normal type, being more akin to cartilage than osteoblasts; and they function badly, producing a delicate and crumbling kind of bone of inferior vitality and strength.

A critical inquiry into the correlation of the two disorders would be out of place here, but it is important to note that in both the changes begin in the embryo and are probably present from the very commencement of the pre-ossification changes. The thought that the phenomena of both diseases may prove to depend upon somewhat similar or allied causes is very natural, and it would not seem impossible for some rare case to present conditions suggestive of both. Such a case is the following.

Hektoen's Case.¹⁷—This was “a short-limbed dwarf supposed to be 45 years of age, who supported himself by selling lead pencils and chewing-gum from a roller. He was presumably of fair intelligence; with a fibroid thyroid without any demonstrable thyro-iodine; with a relatively large cranial vault, made up of 172 Wormian bones, but without any evidence of premature ossification of the synchondroses at the base of the skull; with marked curvatures of the spinal column; with old fracture of many of the ribs and of the left humerus; with great deformity of the pelvis; with curvatures of most of the long bones which are relatively short, the articular ends being swollen into irregular globular masses; with a general and pronounced osteoporosis; and with the absence of trident fingers” (*Fig. 22*).

Discussing the explanation of this peculiar case Hektoen writes: “Cretinism or rickets or osteomalacia in all probability is not wholly responsible for the changes present in the skeleton. Taking all the facts and conditions into consideration it must be acknowledged that the case presents some features best explainable on the score of osteogenesis imperfecta and others best explainable on the score of chondrodystrophy foetalis, but as for reaching definite conclusions it is unfortunate that the picture of either of these two diseases, as now understood, is incomplete in some essential particular; and furthermore nothing is known of this man's earlier history.”

ACHONDROPLASIA AND THE INTERNAL GLANDULAR SECRETIONS.

Certain pathological facts have done much to stimulate interest in the physiology of bone growth. The increased size of the bones and the delayed obliteration of the epiphysial lines in eunuchs (*see R.C.S. Museum, Pathol. Sect., Disorders of Growth, Specimen No. 4846-1*), the dependence of cretinism upon diseased and atrophic thyroids, and the association of acromegaly and gigantism with pituitary conditions, caused attention to be focused more particularly upon the testis, the thyroid body, and the pituitary gland, but other glands believed to provide internal secretion, such as the parathyroids and the pineal—may be said to be observation.

The following sketch of some recent researches suggests that the genesis of achondroplasia may prove to be intimately concerned with abnormal functioning of one or more of them.

FIG. 22.—Hekt. skeleton shows features of osteogenesis imperfecta and some achondroplasia—*see Amer. Jour. Med. Sci.* exxv. 756, *Fig. 5.*)

The So-called Cretinous Calf.—A good deal of literature has been devoted to the 'cretinous calf' and its connection with achondroplasia. Crew¹⁸ tells us that the Irish Dexter is a breed of the smallest cattle in the British Isles, with a short broad head and short legs, two points (brachycephaly and micromelia) which have an important relation to the subject. A Dexter mated with a Dexter bull invariably results in a proportion of dead, misshapen calves. The period of gestation is approximately 284 days, and it can be foretold when a pregnancy will terminate in a 'bull-dog' foetus. About the third or fourth month great abdominal distention sets in, and this is followed by a flow of amniotic fluid. Then the flow ceases and the cycle is repeated. Following one of these discharges the foetus is aborted.



FIG. 23.—One half of the distal epiphyseal border of the metatarsal bone shown in Fig. 10). The compact border occupies nearly the whole width in this section, but not in another one. (This section was taken near the periphery of the bone.) There is a complete absence of proliferation of the cartilage on the epiphyseal side of the compact layer except in the vicinity of a short interruption to the left of and outside the picture. At each corner the first sign of an ingrowth (?) from the periosteum is in evidence. There is very little bone formation on the medullary side of the compact layer. The medulla shows a number of scattered fat-cells; and the cross-section of a considerable vessel lies outside the picture. ($\times 50$.)

The above cycle is not invariable. The first sign may be the abortion of a dead monstrous calf, or a premature labour necessitating operative measures.*

The Dexter 'bull-dog' foetus is very much smaller than the normal foetus of the same age. Its death is associated with severe foetal anasarca (foetal dropsy) in the case of the earlier abortions, and in the majority of the later ones; and with very difficult labour owing to the shape of the foetal head. When there is hydramnios there is foetal anasarca, the foetus being a waterlogged and shapeless mass, and the abdominal wall devoid of skin over a

* The puerperium differs from that following a normal calf: (1) The placenta comes away in small fragments instead of being thrown off complete in three or four hours; and (2) The abortion of the monstrous calf does not interrupt the production of milk, whereas the abortion of a foetus other than a 'bull-dog' does immediately.

circular area based upon the umbilical cord. The anasarca present in the majority of cases is common in cattle, and invariably associated with death and abortion in the sixth or seventh month. Its cause is not known, but in the case of the 'bull-dog' foetus, it is always associated with hydramnios—both probably being due to the same cause.

Crew came to the conclusion "that the conditions found in the 'bull-dog' calf are such as are found in the clinical and pathological entity known as achondroplasia. It would seem that the exhibition type Dexter is a low-grade achondroplast, and that the 'bull-dog' calf produced by the mating of two such individuals is a high-grade achondroplast exhibiting the classical features of the condition in a most pronounced form".

C. G. Seligmann's¹⁹ investigations led him to the conclusion that the changes in the 'bull-dog' calf were due to a deficiency in the thyroid secretion, and that the monsters were, in truth, cretinous calves. He demonstrated the ineffectiveness of their thyroid secretion by intravenous injections of fresh extracts of the gland (50 per cent glycerin) into animals. No fall of blood-pressure, or a very slight one, occurred, and this contrasted with the effect produced when a similar extract, made from a normal newly-born Dexter-Kerry, was employed.

Hogben and Crew,²⁰ turning to account an interesting biological fact, came to quite an opposite opinion. They employed the axolotl test. This larva of the Mexican salamander, when kept in tanks, preserves its larval form indefinitely, but feeding it with potent thyroid tissue causes it to undergo rapid metamorphosis into a fully developed terrestrial amblystoma. By this test it was impossible to obtain evidence of active secretion in the normal foetal thyroid earlier than three months in the sheep and four months in the ox, and practically similar results were obtained in the case of the 'bull-dog' foetus.

The result of an inquiry into the functioning of the *posterior lobe of the pituitary* of the monstrous calf is described by Crew in his communication to the Royal Society. An injection of a minute quantity of posterior-lobe extract into a frog "previously kept under those conditions which conduce to skin pallor" is followed by a very characteristic and marked darkening due to a conspicuous expansion of the melanophores (Hogben and Winton). This result is produced by the posterior-lobe extract of normal cattle at the beginning of the third month, but that of the 'bull-dog' foetus of six months gave a very doubtful reaction, and from one of four months a still more doubtful one. A year or two ago the anterior and posterior lobes were regarded as entirely unconnected glands with different functions, but there is now a tendency to look upon them as one gland, although the distribution of the colloid is unequal in the various parts (Rendle Short²¹). There is reason, therefore, to believe that the melanophore test indicates the functioning of the pituitary as a whole and not of the posterior lobe only. Crew's researches show, therefore:—

1. That the thyroid becomes active in the 'bull-dog' foetus about the same time as in the normal cattle foetus, and some time after ossification changes have begun.

2. That the pituitary becomes functionally active in the normal foetus at the beginning of the third month, i.e., some time before the thyroid does,

and about the time when ossification changes are beginning at the ends of the long bones.

3. That in the 'bull-dog' foetus the pituitary is late in beginning to function, and is largely inactive even at the sixth month.

From these facts it follows that the monstrous calf is not associated with a thyro-iodine deficiency, i.e., is not a cretin, but *may be* related to a deficient pituitary secretion at the time pre-ossification changes are taking place.

Keith²² believed the pituitary showed some histological abnormality ("especially a deficiency of those cells with large-cell bodies picked out by eosin"), but he adds that Professor Shattock thought the sections examined showed no pathological change. The pituitary gland is distinctly smaller in the achondroplastic than in the normal foetus, but this may possibly be attributed to the defective growth of the basis cranii.

THE AMNIOTIC PRESSURE THEORY.

The belief that achondroplasia will eventually be proved to depend in some way upon the internal glandular secretions is not universally accepted. In the past more than one author seems to have believed that pressure, exerted in different ways, would account for some of the phenomena; but its chief exponent is Dr. Murk Jansen, of Leyden. In an interesting and ingeniously reasoned monograph he finds "in the amnion the source of the deforming forces", and he considers the two important conditions to be: (1) Hydramnios; (2) Smallness of the amnion.

In hydramnios, a condition often present in achondroplastic foetuses, the increased tension tends to make the amnion assume a spherical form, and so causes it to exert pressure on those portions of the embryo that project—namely, on the head, the neck, and the tail curves. As a consequence the embryo may become infolded, i.e., coiled up, and the pressure exerted by certain parts squeezed upon others results in deformations. For instance, the pressure on the neck and tail projections will account for the dorso-lumbar kyphosis often seen in these foetuses. In other cases the amnion, from insufficiency of growth, may become too small, and when it completely surrounds the embryo, will again tend to infold it—the embryo accommodating itself to the small space by approaching the ball form. This infolding begins about the third week, when the embryonic tissues are very soft. But as the cartilage develops and the ossific centres form, the embryo becomes more resistant, and the amnion loses its power of infolding (six to seven weeks).

Besides the infolding process, the tension of the amniotic fluid is increased. In consequence of excessive secretion or want of growth of the amnion, ischæmia of the embryo must follow, for the vessels covering the exterior of the yolk sac are outside the amnion and the amniotic pressure squeezes the blood from the embryo into them. The diminished blood-supply produced in this way would interfere with growth, especially of those parts most recently formed and still soft—namely, the extremities. Ischæmia, in Jansen's²³ view, is the cause of the dwarf phenomena.*

* It is difficult to understand why proliferation of cartilage only should be deranged if the ischæmia affected the whole embryo and particularly the soft parts more than those slightly resistant. The development of the softer tissues might also be expected to suffer and to show some evidence of it in the foetus or in cases that survive.

The theory of amniotic pressure is strongly opposed by Keith,²² who voices the more generally held belief that "such indications as are available point to a hormone such as we may expect to arise either in the pituitary, thyroid, suprarenal or genital glands, or by an interaction of the secretion of all of them".

THE SYNOSTOSIS OF THE BASIS CRANII.

In a disease in which the dominating feature is the feebleness of endochondral ossification, the fact that ossification at the base of the skull quickly obliterates the synchondroses calls for explanation (compare Mery and Labbé's case, p. 16).

There is no doubt that the synostosis takes place early. It is an important factor in the want of growth in the length of the base, though a certain share should be credited to deficient growth of the cartilage even before ossification commences. The ossifying process in the cartilage of the basis cranii is similar to that occurring in other cartilaginous parts of the achondroplastic skeleton. For fusion of the nuclei to occur so quickly the tracts of cartilage that separate them must be narrow, and their growth retarded. The cartilage of the spheno-occipital portion of the basis cranii is probably, therefore, unusually short to begin with, so that with the appearance of the nuclei only small synchondroses remain.

The original cartilage increases normally by the growth of cells from the perichondrium, and, when the ossific nuclei appear, by proliferation of its cells at the edge of the ossification zones. By the latter process the continued existence of the synchondroses is provided for. A deficient formation of cartilage by the perichondrium would account not only for the short spheno-occipital portion of the basis cranii, but for the want of lateral growth which is such a marked feature of this part of the base in the adult achondroplastic skull; and when this is combined with an absence of cartilage-cell proliferation, the narrow synchondroses, and the early fusion of the nuclei, can be understood. Clearly the lateral want of growth is not likely to be due to any fault in *periosteal ossification*, which in this affection is either normal or more active than usual in other parts of the skeleton. The mischief probably occurs before the perichondrium takes on the character and function of periosteum. A defective growth of cartilage, at any rate in the hypoplastic cases, is evidently an associated part of the cartilaginous lesion of achondroplasia, though it is usually thrown into the shade by the absence of the cartilage proliferation at the epiphysial lines, which is responsible for the short limbs.

THE RELATION OF ACHONDROPLASIA TO CERTAIN BREEDS OF ANIMALS.

Souques, in his classification, has described a 'partial' form of the disease in which some of the usual characteristic signs are absent. Thus, in rare instances the achondroplastic conditions may be limited to the limbs, or even to the upper or lower limbs alone. It is the partial form which is supposed by many to account for the short bent limbs which distinguish certain peculiar breeds of animals. The 'bull-dog' calf is now generally recognized as an example of achondroplasia, but there has been a conflict of opinion about the

nature of the basset hound and the dachshund. In these animals the short distorted limbs associated with a long body are strongly suggestive of achondroplasia, but the skull is normal and shows no trace of the disorder. Moreover, their pups are born alive and possess the same peculiarities as their parents. Marie regarded them as perfectly normal beings when compared with the true achondroplasiae, who is always a pathological being, and in whom the contracted pelvis is a great obstacle to the propagation of the race. *Regnault*,²⁴ on the contrary, believed that they were the subjects of achondroplasia, and that an anomaly had been fixed intentionally by man to obtain, by means of selection, a race able to enter burrows and dislodge animals. He



FIG. 24.—The fore limb of a dachshund.
(R.C.S. Museum Stores.)



FIG. 25.—The hind limb of a dachshund. The femur is slightly foreshortened. Note the position of the head of the fibula, which is still united by remains of its ligaments. (R.C.S. Museum, *Osteological Catalogue, Mammals*, No. 584A.)

pointed out that nearly every breed of hunting dogs has its corresponding basset breed, and that in the time of Cuvier they distinguished between bassets with bent legs, and bassets with straight legs—the latter representing a slighter degree of the malady.

"Darwin records the case of a ram born in Massachusetts in 1790 having short crooked legs and a long back, which gave rise to an *otter* or *ancon* breed incapable of leaping"; "in crossing with other sheep the offspring was always

perfect in resemblance to either parent, so that by selection a breed of this semi-monstrous character could have been very quickly originated".²⁵ The 'bull-dog' calf is born dead, but there is a race of cattle in Chile and Mexico called 'Natos' which have the bull-dog muzzle, and in some but not in all the limbs are very short. The front legs of a guinea-pig also are very short.

There is no doubt that achondroplasia shows a strong hereditary tendency, but if these peculiar breeds are really 'partial' forms of a diseased condition, not a perpetuated natural sport, the interesting point is that achondroplasia has become stabilized in a partial form. Though the question will remain unsettled until microscopical investigation decides the nature of the ossification process at the epiphysial lines, it may be pointed out that in the dachshund skeleton the head of the fibula is on a level with the head of the tibia (*Fig. 25*)—a definite achondroplastic peculiarity—whereas in the bull-dog it occupies a normal position (*R.C.S. Museum, Osteological Catalogue, No. 589*).

TREATMENT.

In the present state of our knowledge of the pathogenesis of achondroplasia there is no sufficient indication for special treatment in those cases that survive, though cautious pituitary medication may be worth experimental investigation. But if a suitable treatment were known, there could be little hope of arresting the progress of an intra-uterine disease, which in the human being gives no inkling of its presence till the child is born.

In conclusion, I desire to express my gratitude to the many friends who have helped me in various ways in the preparation of this article, and especially to Sir Arthur Keith, Dr. Rodman, Dr. Greenfield, Mr. Plarr, and Col. M. H. Kuaggs.

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TRAUMATIC RUPTURE OF THE NORMAL SPLEEN.

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THIS paper deals exclusively with rupture by violence of the normal spleen. Thanks to its sheltered position behind the costal margin, this organ is comparatively rarely damaged. Having regard to the function of the spleen as a blood reservoir, and its variation in size, as registered by the oncometer, it is likely that a blow received just prior to a meal, when splenic congestion is at its height, would more probably result in rupture than at other times. But this interesting point must always remain a matter for conjecture.

Incidentally, doubt has been cast upon the prevailing opinion that splenic rupture is a commonplace occurrence in malarial¹ countries. McCracken² (1924) inquired of five of the most active surgeons practising in different sections of China (the home of the larang³), and found that they had not seen a single case of ruptured spleen, accidental or spontaneous. On the other hand, in the city of Shanghai rupture of the spleen is a fairly common industrial accident. Ruptured spleen appears, therefore, only to occur frequently where modern industry prevails.

The present paper is founded upon 32 cases, three of which have been under my own observation, and the remainder have been collected from the London Hospital records between 1894 and 1926. The spleen is evidently less frequently injured than the kidney. I was able to collect from the same records 185 cases of injury to the kidney⁴ between the years 1902 and 1923.

Sex Incidence.—Of the 32 cases of ruptured spleen here reviewed, only 3 occurred in women over 14 years of age. The less arduous occupation, and the protection afforded by the wearing of corsets, doubtless accounts for this disparity.

The History.—There is the history of an accident. The nature of the violence was quite clear in every case in this review:—

| | | |
|---|---------|----------|
| Street accident—run over or knocked down by a vehicle | .. | 14 |
| Fall on to a projecting object, e.g., the corner of a table | .. | 7 |
| Kicked in the abdomen | .. .. . | 3 |
| Fall from a height | .. .. . | 3 |
| 'Buffers' accident (compression) | .. .. . | 3 |
| Fall over handlebars of pedal cycle | .. .. . | 2 |
| | | <hr/> 32 |

Recently, Stretton⁵ reported a case of ruptured spleen in which the history was most misleading. The patient, a woman of 37, stated that she was seized with violent upper abdominal pain whilst getting out of bed to pass urine. This author, not being satisfied with the history, made further inquiries, and found that the woman had been subjected to violent coitus two hours before the alleged onset of the symptoms.

Loss of Consciousness.—McCracken draws attention to the importance of a loss of consciousness immediately after the accident. A loss of consciousness

followed the injury in each of the three cases under my observation, and a careful perusal of the case-histories upon which the paper is based goes to show that an initial loss of consciousness is a frequent occurrence.

Absence of Vomiting.—In 11 instances it is recorded specifically that the patient had not vomited. Of the remainder, with the exception of 6 cases, there is no mention of it in the notes, nor is there any record of pre-operative vomiting in the patients' charts. I therefore feel satisfied that vomiting is somewhat exceptional in uncomplicated rupture of the spleen, and this point should prove useful when summing up data before making the diagnosis.

GROUPING AND SYMPTOMATOLOGY.

Cases of rupture of the spleen may be conveniently divided into four groups: (I) *The patient rapidly succumbs, never rallying from the initial shock*; (II) *Initial shock—recovery from shock—signs of ruptured spleen*; (III) *The signs of an intra-abdominal disaster are delayed*; (IV) *Spontaneous recovery*.

Group I.—RAPID SUCCUMBING OF PATIENT.

There are 3 cases belonging to this group. Complete avulsion of the spleen from its pedicle^{6,7} is the type of accident which is most likely to give rise to the symptoms which characterize this group.

A boy, age 5, was run over, and died two hours after admission to hospital. At necropsy the peritoneal cavity was found to be full of blood, and the detached spleen was discovered lying on the fundus of the bladder.

This is the only instance where the patient very rapidly succumbed. Fatal as it certainly is, if not surgically treated, uncomplicated rupture of the normal spleen cannot be classified fairly as a cause of *sudden* death.

Group II.—SHOCK—SIGNS OF RUPTURE.

This is by far the largest group, and more than three-quarters of the total cases belong to it. After the initial shock has passed off, there are signs which point to a serious abdominal disaster. It is not always possible to state precisely which organ is damaged, but in the majority of instances the physical signs should point clearly to the spleen as the site of the injury.

GENERAL SIGNS.—It may here be emphasized how inconstant are the classical signs of internal hæmorrhage. I have repeatedly made notes upon patients in whom constant watchfulness has failed to reveal restlessness or air hunger, and yet at operation or post mortem they have proved to have a peritoneal cavity full of blood. In endeavouring to distinguish internal hæmorrhage from shock, it is surprising how insignificant is the help which can be derived from the clinical laboratory. For instance, one would think that a blood-count would help in the diagnosis of internal hæmorrhage: on the contrary, it is of little, if any, value. Even after a severe internal bleeding, all that this registers is a relative leucocytosis, and Brodin and St. Girons⁸ have shown that there is also a leucocytosis in shock. Pallor is certainly a useful sign, but to wait for increasing pallor is often to court disaster. When the diagnosis is uncertain, a clearly recorded half-hourly pulse chart is above all things of the greatest diagnostic value. The general signs being unreliable, the local signs of ruptured spleen become increasingly important.

LOCAL SIGNS.—

1. *Abdominal rigidity* is variable, but it is present in more than half the total cases. It is often most pronounced over the left upper abdomen.

2. *Local tenderness* is very constantly found.

3. *Shifting dullness in the flanks* is probably regularly present. It was freely demonstrable in each of the three cases which I had the opportunity of examining personally. *Ballance's*⁹ *sign* is said to be pathognomonic of splenic rupture: there is a dull note in both flanks, but on the right side it can be made to shift, whereas on the left it is constant. The interpretation of the sign is that there is blood in the peritoneal cavity, but the blood in the neighbourhood of the lacerated spleen has coagulated. There are many references to this sign in the literature, but the consensus of opinion appears to be that it so rarely present that it is almost valueless (Barnes,¹⁰ Eliot,¹¹ etc.).

4. *Abdominal distention* commences to appear about three or four hours after the accident, and is probably due to ileus.

5. *Kehr's sign* is referred pain in the left shoulder.^{12, 13, 14} There may be hyperæsthesia in this area. Though probably not especially looked for, left-sided shoulder pain was noted in three of the cases under review. Occasionally it is very much in evidence.

A boy, age 5, fell off a wall. He walked home, but complained of abdominal pain. On examination in hospital late in the afternoon, there were very well-marked signs of ruptured spleen, but the boy's chief complaint was of pain in the left shoulder. The shoulder was examined, and nothing abnormal could be found, so the joint was X-rayed, but no abnormality was revealed. The spleen was successfully removed. There was no further note on the shoulder pain.

MORTALITY.—Between 1894 and 1914 there were 11 cases, with 3 recoveries. Between 1914 and 1925 there were 12 cases and 11 recoveries; the case which died was complicated by a ruptured right kidney. These figures are a striking tribute to surgical progress.

Group III.—THE DELAYED TYPE OF CASE.

Whereas all cases belonging to *Group II* had splenectomy performed between three and twenty-three hours after receiving injury, there remain 6 cases in which from three to thirteen *days* elapsed between accident and operation. In these 6 cases, which constitute *Group III*, after the initial shock had passed off the symptoms of a *serious* intra-abdominal catastrophe were postponed for a varying period. To quote an actual example which typifies this group:—

A navvy, age 40, was hit in the upper abdomen by a pole. He fainted, but soon recovered sufficiently to walk to hospital, where he was examined and told to report the next day. On the morrow he felt better, and stayed at home. Five days later he was brought in with well-marked signs of internal hæmorrhage, having collapsed at home a few hours before admission. Splenectomy was successfully performed.

Delay of serious bleeding may be explained in one of three ways: (1) The great omentum, performing its well-known constabulary duties, shuts off that portion of the general peritoneal cavity in the immediate vicinity of the spleen; (2) A bloody coagulum temporarily seals the rent; (3) A subcapsular hæmatoma forms, and later bursts. It is probable that each of these three factors, at one time or another, temporarily arrests serious hæmorrhage.

A point worthy of earnest consideration is the baffling friability of the splenic pedicle which is sometimes encountered. 'Friable pedicle' appears to be the peculiar terror of the delayed case, for it was found only in cases belonging to this category. The explanation of this phenomenon is fairly clear. The pedicle, after being surrounded by mildly infected blood and blood-clot for a varying time, itself becomes œdematous, and commences to undergo degeneration. It is thus more likely to be found in those cases in which serious hæmorrhage has been postponed by an omental barrier.

It behoves us therefore, when dealing with the delayed case, to take particular care to avoid this calamity. A mass ligature is more likely to cut out than a series of smaller individual ligatures applied by transfixion with a sewing needle close to the spleen. Further precaution is necessary to avoid 'losing' a pedicle which has cut out. C. H. Mayo has immortalized the slipped renal pedicle, which, he says, 'fairly jumps into the fingers' when nimble fingers promptly follow its retraction into the depths of the wound. If the lienorenal ligament, with its vascular contents, slips or cuts through, it might be possible to retrieve it by the same means, but there are few of us who would not rather be forewarned!

MORTALITY.—Of the 6 cases belonging to this group, 3 died—two certainly, and one probably, directly owing to 'friable pedicle'. All the deaths occurred prior to 1914.

Group IV.—SPONTANEOUS RECOVERY.

From time to time cases have been reported where the spleen was supposed to have been ruptured,^{15,16} and with rest, and perhaps the administration of some ergot, the patient has recovered. Professor H. M. Turnbull informs us that neither he nor his colleagues have seen at necropsy a spleen containing the scar of an old injury. On the other hand, Sir Charles Gordon Watson¹⁷ has described two specimens in the museum of St. Bartholomew's Hospital which contained *recent* scar tissue. The patients from whom these specimens were obtained died three and ten days respectively after an accident, from injuries other than those to the spleen. Inasmuch as no fewer than thirteen days have elapsed between the injury and the onset of serious symptoms in one of the cases included in *Group III* of this paper, who can say whether the scar tissue of the St. Bartholomew's specimens would have stemmed the tide of an improving blood-pressure had the patients lived? Again, hæmorrhagic solitary cysts of the spleen are generally attributed to injury. Whilst admitting the possibility, it is not clear why these cysts are usually found in women.¹⁸

The whole question of the natural repair of a splenic injury is an unimportant one. Nature fails so frequently that we must assume that surgical aid is always needed.

OPERATION AND COMPLICATIONS.

Operation.—

The Incision.—The left paramedian incision is justly popular for splenectomy. Nevertheless, in an emergency the supra-umbilical mid-line incision

offers certain advantages. Foremost among these is the speed with which the abdomen may be opened or closed. In a doubtful case a useful practice is to make a 'button-hole' incision immediately above the umbilicus. If the diagnosis is confirmed, the incision can be rapidly enlarged towards the xiphisternum.

That the mid-line incision is usually adequate for removal of a ruptured spleen is, I think, well illustrated by one of my patients, a fat, barrel-chested man of 52, from whom the spleen was successfully removed by this route. Plumptre¹⁹ has already drawn attention to the facility with which the splenic pedicle can be reached from this centrally-placed incision. In those rare instances where more room is required in order to deal with an adherent organ, the incision can be enlarged by a transverse cut to the left. Auvray's costal resection, which is recommended by Lejars²⁰ as the best approach for removal of a lacerated spleen, appears to be absolutely unnecessary.

Dealing with the Injured Organ.—Thirty-four years have passed since Riegues,²¹ of Breslau, performed the first successful splenectomy for rupture. Since that time both tamponade and suture have had their advocates, but splenectomy has come into its own, and is now the standard operation for ruptured spleen. Splenectomy, in contrast to other methods, is rapid and certain. If time permits, it is advisable to examine the tail of the pancreas, and, if this is damaged, many complications may be minimized by a tube brought out on the left flank.

The Question of Transfusion.—An ideal method would be to transfuse the patient with matched blood as soon as the pedicle is ligatured. In practice there are many difficulties in the way. Even if a suitable donor is at hand, the necessary skilled assistance is not always available. Hauke²² recommends transfusion of the blood from the peritoneal cavity. The blood is collected, mixed with citrate solution, and returned to the patient's veins. This collection of blood, especially as the incision is in the upper abdomen, must be time-consuming, but may possibly be facilitated by a suction apparatus. It must again be taken for granted that there is the necessary skilled assistance at hand, if this ingenious method is to be used.

In the majority of instances the infusion of saline must, of necessity, be substituted for the more ideal method of blood transfusion. A good method for the single-handed surgeon is to commence the operation by inserting the needles of a subcutaneous apparatus into the breasts, and allow saline to be absorbed during the operation. At the conclusion of the operation, if it is deemed necessary, the needles can be left *in situ*, and the infusion is continued when the patient is returned to bed.

Early Complications.—By early complications are meant those which occur during the patient's stay in hospital.

Peritoneal Effusion, amounting to ascites, was seen in one of my cases. It was noted on the eighth day after operation, and was accompanied by slight pyrexia. The fluid began to lessen in amount about the fourteenth day, but was demonstrable until the end of the fourth week. Its presence can be accounted for by a leakage of the pancreatic ferments from a wounded tail of the pancreas into the greater sac. It is well known that a large collection of fluid accumulates rapidly in the lesser sac after a traumatic lesion of the body of the pancreas.

'Burst Abdomen'.—The wound burst open, and had to be resutured under a general anæsthetic, in no fewer than four cases.* The most feasible explanation is that pancreatic ferments digest the edges of the abdominal wound and the catgut contained therein. Connors²³ noted three cases of severe suppuration of the abdominal wall following splenectomy for rupture. He reported that he had diligently searched the literature for the explanation, but had not found it. I submit that digestion of the edges of the wound, which undoubtedly occurs, would favour this infection. The tail of the pancreas may be wounded when splenectomy is being performed, or, as is probably more usual, it is injured together with the spleen at the time of the accident. There is good authority for the latter conjecture, for at the necropsy of one case of ruptured spleen which died without operation the tail of the pancreas was found to be almost severed.

Left Pleural Effusion.—A pleural effusion on the left side was noted in three instances, and was treated by repeated aspiration. The infrequency with which pleural effusion complicates fractured ribs makes it more probable that the effusion is due to bruising of the diaphragm at the time of the accident, or during removal of the spleen, than to a concomitant injury of the lateral thoracic wall.

Persistent Hiccup.—Hiccup was observed in several cases. A persistent hiccup, lasting more than five days, and preventing sleep, seriously complicated the convalescence of one patient; fortunately it was controlled by morphia, and he recovered. Hiccup is probably due to irritation of the branches of the left phrenic on the surface of the diaphragm.

Splenic Asthenia.—This occasionally complicates early convalescence.^{24, 9} It commences about the tenth day after splenectomy. The patients become progressively emaciated. There is often some pyrexia. Irritability of temper is rather characteristic. The condition tends to improve on the exhibition of arsenic. The post-operative notes are not complete enough to draw any conclusions on the incidence of this train of symptoms.

The other complications—general peritonitis (two cases) and intestinal obstruction (two cases)—require no detailed consideration.

Late Complications.—The majority of the patients who have been traced report that they are in perfect health. The following information has accrued from tracing patients, and it throws some light upon the late complications of normal splenectomy.

Attacks of Palpitation when Lying upon the Left Side.—Two patients independently and spontaneously complained that for many months after their operation they were unable to lie in bed upon the left side without evoking an unpleasant attack of palpitation. Temporary cardiac embarrassment might result from loss of support to the under surface of the left cupola of the diaphragm. There is no denying that the spleen must offer some resistance to the excursions of the diaphragm in this region. The lack of this support, as far as the heart is concerned, would be most in evidence when the patient lay upon his left side.

Fleeting Bone Pains.—Pains in the bones 'like rheumatism' is a well-known late complication of splenectomy. It is due to the metamorphosis of

* The paramedian incision had been used in each of these instances.

yellow into red bone-marrow. There was only one instance in which this seriously worried the patient, and he stated that he was able to relieve the pain by rubbing his limbs.

Attacks of Vomiting.—During the first six months attacks of vomiting proved a considerable handicap to the return to normal life of three patients. The most striking instance was a patient who was employed as a flautist at a music hall. On returning to work he found that the act of blowing a flute caused him to vomit. This persisted for over three months, and then the symptoms abated. Possibly the loss of the spleen, a great blood reservoir, predisposes to passive congestion of the stomach.

Experiments on animals have led investigators²⁵ to believe that splenectomy lowers resistance to infection. It is often stated that, as far as man is concerned, there are not yet sufficient data upon which to settle this important question.^{2, 16, 27, 28} I am able to trace 13 cases who have had a ruptured normal spleen removed. Two of these were operated upon 14 and 13 years ago respectively. In the remainder, between 3 and 11 years have elapsed since the operation. In no instance is there the slightest indication that a splenectomized person is more susceptible to infection than the rest of humanity.

I beg to record my thanks to the Surgeons of the London Hospital for permission to include in this paper cases under their care.

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SPONTANEOUS RUPTURE OF THE SPLEEN.

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SPONTANEOUS rupture of the spleen is now a well-known catastrophe, but in most of the cases recorded the spleen was pathological; in many the disease had already been recognized; in others it was only found after operation or death. In the case reported here the spleen was apparently normal, and no history of injury was obtained from either the patient or his friends.

SPONTANEOUS RUPTURE OF THE ABNORMAL SPLEEN.

This subject has often been written upon and discussed; it is briefly considered here as an introduction to spontaneous rupture of the normal spleen.

Malaria is the disease in which the spleen most frequently ruptures spontaneously.¹⁻⁶ Noland and Watson⁷ found only 3 cases amongst 30,000 malarial patients at the Colon Hospital in eight years, but the condition seems to be commoner than these figures suggest. Of 123 spleens ruptured by injury, 93 were found by Berger to be malarial.

The condition occurs more rarely in typhoid fever. Connor and Downes⁸ in 1914 could trace only 12 cases, in 9 of which it was found at autopsy; in the other 3, operation was performed for supposed intestinal perforation; none recovered. All were males, and the time of rupture varied from the second week to convalescence and relapse. Bryan³⁴ describes 25 cases, but in some of these the nature of the fever was doubtful.

The spleen has ruptured spontaneously in pregnancy, parturition, and the puerperium.^{9, 10, 11} In these cases the spleen was softened and enlarged. Stretton¹² recently reported a case of rupture of a normal spleen in a woman five months pregnant; it seemed to happen spontaneously as the patient got out of bed, but Stretton thinks it really occurred during coitus a few hours before.

Hammesfahr¹³ and Friesleben¹⁴ have reported examples in leukaemia. A boy with hæmophilia has been cured of his disease by splenectomy done for spontaneous rupture¹⁵; this is claimed as the sixth case in which splenectomy has cured hæmophilia.

Rupture of the spleen may occur in the course of acute infections—for example, after appendicectomy and influenza¹⁶; with a carbuncle and marked toxæmia¹⁷; with a septic hand¹⁸; and with a whitlow¹⁹; in the last case there was a metastatic abscess in the spleen. It is rarer in tuberculous disease. Cannaday²⁰ had a case in which there was a spontaneous rent on the inner aspect of the spleen, which was studded with tubercles and occupied by caseous and calcareous deposits; the right kidney was also disorganized. Although this is an obvious example of rupture of a tuberculous spleen, it has been quoted in the literature as a case of spontaneous rupture of a normal

spleen.^{21, 22} The remaining diseases in which the spleen has ruptured spontaneously are even rarer: typhus fever, relapsing fever, cystic degeneration, malignant growth, hydatid disease, infarction, torsion, abscess, and varices.

SPONTANEOUS RUPTURE OF THE APPARENTLY NORMAL SPLEEN.

Connors,²¹ writing in 1921, stated that he could find only two cases, those of Shorten²³ and Cannaday;²⁰ but as the latter case was that of a tuberculous spleen it must be omitted. Moynihan²² in 1926 wrote that in only three cases of spontaneous rupture was the spleen normal in size and in texture, but he also included Cannaday's case, while he omitted the two of Metcalfe and Fletcher.²⁴ I have found records of four definite and two doubtful cases.

Connors' Case.—Connors' patient²¹ was a man, age 38, who had been treated for bronchitis and was suspected of having pulmonary tuberculosis; he was a heavy drinker. Three months before admission to hospital he had complained of pain in the right hypochondrium, aggravated by deep breathing, and of nausea and constipation. On the day he came to hospital he had felt a severe pain in the left hypochondrium. Radiograms showed obstruction at the splenic flexure, and the pre-operative diagnosis was stricture of the colon, probably malignant.

At operation the gut was found to be normal. There was a hæmatoma beneath the capsule of the spleen, and the spleen itself was almost bisected longitudinally; bleeding had ceased. Recovery followed splenectomy.

The spleen was apparently normal in size and consistency, but no microscopical examination was made. Subsequent inquiries negatived injury, malaria, or typhoid fever. The patient returned three months later, complaining of indigestion and abdominal pain; there was a tumour in the left hypochondrium which was found at operation to be a cyst, probably pancreatic; Connors considered that it was due to injury to the pancreas during removal of the spleen. This patient died of pulmonary tuberculosis four years later; there is no record of an autopsy.

Shorten's Case.—This patient²³ was a man, age 43, who was admitted to hospital six hours after the sudden onset of peri-umbilical pain and vomiting. The abdomen was tender and rigid; liver dullness was normal; there was shifting dullness in the flanks. Signs of bronchitis were present.

At operation three hours later Shorten found fluid and clotted blood in the peritoneal cavity; the spleen was almost divided into two equal parts, the tear extending from the convex surface to the hilum; it was still bleeding. Splenectomy was done. The gall-bladder was full of small stones, but was not treated. The patient recovered. The spleen was normal in size and weight and histologically. There was no stripping of the capsule to suggest a preliminary subcapsular hæmorrhage, nor were there any adhesions about the spleen.

The patient's health had been good except for winter bronchitis. Eighteen months previously he had been buried in the trenches, whence he had been sent to hospital with severe abdominal pains; he had been discharged after three months and had had no return of pain. In Shorten's opinion the absence of subcapsular hæmorrhage and of adhesions makes it unlikely that the injury received one and a half years before was in any way connected with the rupture.

The question of remote injury as a factor is discussed later.

Metcalfe and Fletcher's Cases.—These writers report two cases, both of which recovered after splenectomy.²⁴

The first was a white male, age 21. He complained of sudden severe pain in the left side of the abdomen radiating to the left shoulder; he vomited twice, and

was shocked. A few hours later he had paroxysmal pain in the left upper quadrant of the abdomen; he was tender here, but there was no rigidity or distension of the abdomen. The leucocyte count was 25,000 cells per c.mm. There was no history of injury or malaria; the Wassermann reaction was negative. The patient had had influenza and pneumonia a few years before. He had never had any gastric symptoms. At operation blood was found in the peritoneal cavity and the spleen was ruptured (the site is not stated). Splenectomy and recovery. The spleen appeared normal macroscopically and microscopically.

The second case was also a male white, age 21, who had had no serious illness or injury. After a large drink of cold water he was seized with cramp-like abdominal pain; he complained also of dizziness and pain in the left shoulder. He was admitted to hospital for observation; he got up next day, but again felt abdominal pain and dizziness; later the pain became worse and he showed signs of shock and internal hæmorrhage. There was no rigidity or distension (tenderness is not mentioned); the flanks were dull to percussion. The following day he seemed better, but still had pain in the abdomen and left shoulder; there was still no rigidity or distension, but the area of dullness in the flanks was larger. At operation blood was found in the peritoneal cavity and there was a clot around the spleen, which had ruptured on the convex surface. Recovery followed splenectomy. The spleen was normal macroscopically and microscopically.

Skerritt's Case.—Skerritt,²⁵ reporting his case of spontaneous rupture of the spleen, does not state definitely that the organ was normal, though his account indicates that it was. His patient was a man, age 53, who had been complaining of nausea, pyrosis, and anorexia for two months; once during this time he had severe epistaxis; he was admitted to hospital on account of a second attack of nose-bleeding. He was blanched; the radial pulse was feeble, and the vessel wall degenerate; a hæmic systolic bruit was heard. Nothing abnormal was found on abdominal examination. Later the patient became suddenly dyspnoic, and died in collapse within an hour; he had been lying quietly in bed for several hours before his death.

At autopsy much dark blood was found in the peritoneal cavity. The capsule of the spleen was distended with blood-clot, and there was a tear 1 in. long on the anterior part of the concave surface. The splenic substance was described as being soft and pulpy, due to considerable post-mortem changes. The spleen and clot together weighed 26 oz., but the weight of the spleen alone is not given. There is no report of a microscopic examination. The remaining organs were said to be anæmic but healthy.

Atkinson's Case.—This is the only case in which the patient was a female.²⁶ Her age was 35. She had not been well since her marriage five months before, complaining mainly of frequent attacks of vomiting and occasional epigastric pain. One night she became suddenly very ill, vomited frequently, and soon after had pain in the left hypochondrium, which radiated all over the abdomen. She died in a state of collapse twenty hours after the onset.

Post mortem a large clot weighing several pounds filled the left side of the abdomen; much fluid blood was also present. There were no adhesions, inflammatory lymph, or peritonitis. The spleen was described as being shrunken, pale, and flabby, and the lower pole as being in a state of muddy pulp.

Atkinson does not say whether he considered the organ to be diseased or not; no microscopic report is given. The other abdominal organs were healthy.

The last two cases were only very briefly reported, and must be considered as doubtful examples of spontaneous rupture of a *normal spleen*.

AUTHOR'S CASE.

This patient was a man, age 53, a grocer by occupation; seventeen hours before admission to hospital he felt sudden severe pain in the upper part of the abdomen as he bent down to lift a bucket of water in his right hand. He had

retching, but was not sure if he vomited. His previous health had been good up to the last three months, during which he had had attacks of flatulence and indigestion after meals, but he had at no time been sufficiently ill to discontinue work or consult a doctor. He had never had any of the fevers, and the patient and his friends were quite sure that there had been no injury either recent or remote. Much of this information was only obtained after operation.

ON EXAMINATION.—The patient was obviously very ill and in great pain; his temperature was 98.6°, the pulse was 80 per minute and of poor volume. He had well-marked *areus senilis*. There was generalized board-like rigidity of the abdomen with marked distension; tenderness was most exquisite in the epigastrium and left hypochondrium. The abdomen was resonant all over and liver dullness greatly decreased. He had pain in the right shoulder as well as in the abdomen. A pre-operative diagnosis of perforated peptic ulcer was made.

OPERATION.—I opened the abdomen through a right paramedian incision. There was no free gas or fluid in this part of the peritoneal cavity; it was immediately obvious that the distension was due to gas in the transverse colon, which had to be punctured before the exploration could be satisfactorily continued. The stomach, duodenum, biliary tract, and appendix were all intact. The hand was then passed into the pelvis and brought out dripping blood; this was the first indication that there was any free fluid present. The spleen was soon found to be the source, and it was removed. There was no active bleeding at the time of operation and only 10 or 12 oz. of blood in the peritoneal cavity. The patient never improved, and died three days after operation with extreme paralytic ileus.

AUTOPSY.—Some clot was found about the pedicle of the spleen; the ligatures were intact and a small piece of pancreas was included in one of them. The whole of the gut was very distended. The other abdominal organs were healthy; so were the heart, aorta, and the splenic and renal vessels. The base of each lung was congested.

The spleen was normal in size, shape, and consistency; there was a hæmatoma, almost as big as the spleen itself, beneath the capsule on the convex surface, where there was a tear about 1½ in. long and ½ in. deep, transverse to the long axis and midway between the upper and lower poles. The spleen was carefully dissected in a search for some abnormality; but none was found.

Microscopical examination was made of the spleen, liver, kidneys, heart muscle, the splenic and renal arteries, and a lymph gland; all were histologically normal.

CLINICAL FEATURES OF SPONTANEOUS RUPTURE OF THE SPLEEN.

It is generally agreed that these closely resemble those of traumatic rupture; but in the cases reviewed here there are some points of difference—for example, abdominal rigidity and tenderness, usually so marked in traumatic rupture, were not conspicuous features in the two cases reported by Metcalfe and Fletcher, nor in Connors' case; but they were well marked in Shorten's patient and in mine. Dullness in the flanks was found in the case of Connors and in one of the cases of Metcalfe and Fletcher; it was absent in my case and not mentioned in others. Ballance's sign, shifting dullness in the right flank and fixed dullness in the left, must cause distress, especially as it indicates a large amount of blood. Villalobos²⁷ has noticed a fine friction rub in the left flank, detectable by the stethoscope and by the hand.

Pain in the left shoulder has been noted in many cases of ruptured spleen, traumatic and spontaneous; it was present in both cases of Metcalfe and Fletcher. My patient said he had pain in the right shoulder, but he was mentally clouded when first seen and may have meant to say left; I can find no other case in which pain was referred to the right shoulder.

Trendelenburg,²⁸ discussing traumatic rupture, says that vomiting is a guide, as it is usually absent in cases of injury to the alimentary canal; on

the other hand, Melchior²⁹ states that vomiting is rare in rupture of the spleen. It occurred in Shorten's case, one of Metcalfe and Fletcher's, and in Atkinson's. Nausea was a symptom in Connors' patient, and my patient had retching.

Intestinal paresis was extreme in my patient, but was either absent or not obvious in the other cases. Nystrom³⁰ has reported three cases of ruptured spleen in which intestinal distension was severe; he added that he could find only one other case of ileus from this cause. In Nystrom's three patients the spleen was either sutured or tamponed, not removed; all recovered, but two required further operation for ileus. Hansell³¹ has reported a similar case, and this may be the one to which Nystrom referred. In many cases unconsciousness has occurred; it is presumably syncope due to loss of blood; some of these were rapidly fatal without localizing features.

Does peritonitis ever occur? Hubbard⁹ says: "Peritonitis has never been observed to follow rupture of the spleen, although it follows rupture of the liver, pancreas, and other abdominal organs". Ledderhose³² writes that "After rupture of the spleen, peritonitis does not occur". Gordon-Watson,²³ however, states that "If the patient survive the hæmorrhage and no operation be performed, he may yet succumb to peritonitis". Moynihan²² mentions peritonitis as a possibility in unoperated cases. Gordon-Watson and Moynihan do not state if they have ever found peritonitis present at operation; they only mention it as a possibility in unoperated cases, so it must be a late event if it does occur. There was no peritonitis in my patient at the operation or at autopsy, and it is not recorded in any of the other cases reviewed here.

In my patient there was no more than 10 or 12 oz. of blood in the peritoneal cavity, his poor condition being due more to paralytic ileus than hæmorrhage; I found blood only on exploring the pelvis and left paracolic region. Melchior²⁹ has drawn attention to the point that in ruptured spleens the extravasated blood tends to spread at first only in the left half of the abdomen, whence it reaches the pelvis, and only when this is filled does the blood rise into the right half of the belly. Bryan³⁴ in a patient with a ruptured typhoidal spleen, only found blood in the pelvis and during evisceration.

Site of Rupture.—Of these 7 cases in which the spleen was apparently normal, rupture was on the convex surface in 3 (Shorten's, one of Metcalfe and Fletcher's, and mine): in 1 (Skerritt's) it was on the concave side; the site of rupture in the remaining three is not stated.

Cantlie³⁵ calls attention to the frequency of rupture on the concave surface in malarial spleens resulting from trauma, although in many cases of spontaneous rupture it is on the convex side. Leighton,³⁶ reporting a case of rupture on the convex side of a malarial spleen, quotes Deadrick,⁴³ who says that laceration occurs with equal frequency on the concave and convex sides.

Friesleben¹⁴ states dogmatically that "the rent in spontaneous rupture, in contrast to traumatic ones, is always on the convex side", but in Skerritt case the tear was on the concave side.

Connor and Downes,⁸ writing on rupture of the typhoidal spleen, that the rupture may involve any part of the surface and is usually. Ledderhose³² also states that the rupture may be situated on any part

organ; multiple rents have been found, and in rare cases complete separation of the spleen into two or more pieces has occurred.

MECHANISM AND ETIOLOGY OF THE RUPTURE.

The mechanism of rupture of a pathological spleen, especially the malarial and typhoidal, has been discussed by many writers: Bryan,³⁴ Nolan and Watson,⁷ Ledderhose,³² Friesleben,¹⁴ Foucault.³⁷ All have closely identical views on the causes, which may be summed up as: (1) Softening of all the structures of the spleen; (2) Congestion of the portal vein and its radicles and inability of the narrow splenic vein to accommodate itself; (3) Blood is thus forced between the spleen and the investing peritoneum, and finally the latter gives way; (4) Perisplenic adhesions, by fixing the organ, predispose to rupture.

With many ruptured spleens, as in my case, a subcapsular hæmatoma has been formed; this supports the suggestion that there are two stages: first an effusion beneath the capsule, then secondary rupture of the latter. A similar process is known to occur in some cases of rupture of the liver. These subcapsular hæmatomata may form cysts, and several cases of successful operation at this stage have been reported (Planson³⁸).

Wohl³⁹ points out that histologically the spleen ages early, and he thinks that these early degenerative changes predispose to its rupture; at the age of 36 nearly 50 per cent of spleens show thickening and hyaline changes in the Malpighian bodies and capsule, and the blood-vessels become thickened. But these factors must be subsidiary, otherwise it would be more common and would increase in frequency with age, as do, for instance, rupture of the fibroid heart and spontaneous fracture in degenerate bone—the neck of the femur, for example.

Ledderhose³² and Foucault³⁷ are both sure that spontaneous rupture occurs exclusively in the diseased spleen. If they are correct, then in the cases here discussed the spleen is only apparently healthy; yet no evidence of disease was found. A possible explanation is that the spleen is abnormal at one area only, that rupture occurs at this spot, and all evidence of pathological change is destroyed by the disintegration associated with the rupture. Of the seven cases, five had digestive symptoms; two of these had conditions in other organs sufficient to account for these symptoms—namely, gall-stones and pulmonary tuberculosis respectively; in the remaining three no cause for the gastric symptoms was discovered. I suggest that some localized disease in the spleen caused these symptoms first, and later the spontaneous rupture which obliterated evidence of the disease. My patient had complained of flatulence and indigestion for three months; Skerritt's patient had had nausea, pyrosis, and anorexia for two months; and Atkinson's had suffered from occasional epigastric pain and frequent vomiting for five months. This suggestion receives further support from the fact that the digestive power of the gastric juice is constantly weakened after removal of the spleen; it is conceivable that a gradual loss of the spleen by disease would similarly affect the gastric juice; it is supposed that the spleen provides a substance which causes the gastric glands to secrete more pepsin.⁴⁰ The close anatomical relation of the spleen to the stomach, and the rhythmical contractions which

it undergoes during digestion, still further make it likely that early splenic changes produce gastric symptoms. Finally, well-known splenic diseases such as Banti's disease are frequently mistaken at first for gastric or duodenal disorders.

Of the seven cases, only two, those of Metcalfe and Fletcher, had no gastric symptoms; they were both vigorous young men of 21 and may have had minor symptoms which were not mentioned.

In none of these cases was there any evidence of softening and congestion, the conditions which are blamed for spontaneous rupture of enlarged spleens, as in malaria and typhoid fever. There remains the possibility of some remote injury, perhaps forgotten or unnoticed, being the underlying cause of the rupture. Remote injury was considered in the case of Shorten, but was negatived for the reasons given; in each of the remaining cases injury is definitely denied. But a case reported by Jackson¹¹ warns us that rupture of the spleen may occur at an appreciable time after an injury and the association between them be missed.

Jackson's Case.—The patient was a girl, age 15, who suddenly developed pain in the left lower quadrant of the abdomen while at a cinema show; she vomited, and showed signs of collapse; the belly was rigid all over, and there was dullness in the flanks. On asking about her previous health one only learnt that she had complained of not feeling well for several days about a month before.

At operation blood was found in the peritoneal cavity; the source was a rent of the convex surface of the spleen, which was large and œdematous. Recovery followed splenectomy. It was only during convalescence that the child was able to give a reliable history; she stated then that she had hurt her left side against a desk at school twenty-eight days before the operation; she complained only of not feeling well and did not tell anyone of this injury. This case might easily have been counted as one of spontaneous rupture if the patient had not lived to give her history.

Lemprière's Case.—This author¹² had a male patient, age 15½ years, who was injured at football: he had epigastric tenderness, vomiting, and shock, but seemed to recover completely in a few days; on the eighth day he played squash rackets and suddenly collapsed with acute abdominal pain. At operation a rupture was found on the concave surface of the spleen. The interval of eight days between the injury and the rupture might well have been prolonged if the boy had rested longer.

Two specimens in the Museum at St. Bartholomew's Hospital support the possibility suggested by these two cases, that temporary, if not permanent, healing of a ruptured spleen may occur. These specimens are described by Gordon-Watson.¹³ One is the spleen of a woman, age 30, who fell thirty feet and fractured a femur; she died ten days later without ever having abdominal symptoms: there was blood about the spleen, which had evidently been torn across, and a firm white scar had formed between the lacerated surfaces. The other specimen was removed after death from a woman, age 39, who was run over by an omnibus and died sixty hours later. The spleen had been torn on the outer surface near the upper pole and the rent was closed by a firm clot.

There must be other similar cases and specimens. These few are cited to show that an apparently spontaneous rupture of the spleen may really be a traumatic one with delayed symptoms—due either to the bleeding being subcapsular at first and intraperitoneal later, or to a temporary clot in the tear yielding after an appreciable interval.

SUMMARY.

1. A case of spontaneous rupture of an apparently normal spleen is recorded; only six similar cases could be found in the literature.

2. Of the seven cases, five had previous digestive symptoms; of these five, one had gall-stones and another pulmonary tuberculosis and alcoholism; in the remaining three no cause of the digestive symptoms was found; possibly they were due to some splenic lesion, evidence of which was destroyed at the time of rupture.

3. Injury to the spleen may cause no immediately alarming symptoms, so that the association between an injury and subsequent rupture of the spleen is overlooked. Post-mortem specimens of healed spleens, and clinical cases of delayed rupture of the spleen, have been described to show that some cases of apparently spontaneous rupture are really traumatic.

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CANCER OF THE TONGUE: PRELIMINARY REPORT ON RADIUM TREATMENT.

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IMPRESSED by the results obtained by Professor Regaud at the Institut de Radium in Paris, we have given his methods due trial in cases of lingual cancer. The results have been so gratifying that we consider them worthy of record. For the present we make no comment on the theories underlying radium therapy or on the physical or biological problems; we are here concerned only with the clinical findings in seventeen cases of undoubted carcinomata of the tongue and of the changes effected in them by the application of radium. In each case the growth treated was examined microscopically; the local appearance at intervals can be seen in Mr. Sewell's drawings; the changes detected by palpation are noted. The method of radium application and the dosage in each case are given.

That the changes effected locally are striking is obvious; in some cases the effect on malignant structures somewhat remote from the site of the primary lesion is also striking (*see Figs. 38, 39*). As to whether these changes are permanent, time alone will decide, but the disappearance of the neoplasm appears to be so complete that in our opinion even early and operable cases should be submitted to radium rather than any other form of treatment, including surgical excision and diathermy.

The problem presented by a case of lingual cancer is twofold: the planning of the actual radium therapy of the primary growth; and the treatment of the lymphatic area draining the tongue.

CONDITIONS AFFECTING TREATMENT.

Type of the Growth.—We are only considering the squamous-celled carcinomata. As a rule it can be stated that the condition of the surrounding area profoundly affects the results obtained. Cases where the growth is of the fungating cauliflower type or of the smaller papillary form give good results. The ulcerative type is rather more resistant to treatment, but if small gives equally good results. The worst type of growth is that which is embedded in an œdematous zone—whether the growth be of the nodular infiltrating variety or of the fissured ulcer type.

Whatever the karyokinetic activity of the malignant cells may be, they respond to irradiation; but if the stroma be œdematous, it is not sufficiently resistant to the irradiation however well screened the radium may be; its blood-supply is interfered with, and radionecrosis is very probable (*see Case 2*).

The suitability of a case for radium therapy depends upon two principal factors: (1) The degree of extension of the lesion; (2) The anatomical

position of the lesion. The question of glandular involvement does not *per se* materially alter the treatment of the primary growth, although it profoundly influences the prognosis and demands a more careful consideration of dosage. Even with obvious glandular infection the primary growth can be got rid of, and then the question of the treatment of the lymphatic area is considered separately.

Size of the Growth.—The smaller the growth, the easier the treatment and the better the prognosis. A large carcinoma presents difficulties of adequate protection of the surrounding bony structures, as a larger quantity of radium is required; hence the greater danger of radionecrosis.

Anatomical Position of the Growth.—Epitheliomata of the tip, lateral border, and dorsal aspect of the tongue anterior to the V-shaped row of papillæ are most suitably situated for treatment by radium, since they are easily accessible and the jaws can be efficiently protected by a simple apparatus containing a lead lining. The apparatus interferes very little with deglutition, it can easily be kept clean, and the pathological area is under continuous supervision. Epitheliomata of the inferior surface of the tongue are harder to treat, and when the floor of the mouth is invaded by the disease the difficulty is still greater, for it has now become less easy to design an apparatus which will efficiently shield the lower jaw from necrosis. But even the fear of necrosis should not deter from the use of radium, seeing that surgical treatment of the same condition will necessitate excision of part of the floor of the mouth, and possibly of the adjacent portion of the mandible.

Epitheliomata of the posterodorsal part of the tongue and of the posterolateral part in the vicinity of the pillars of the fauces are the most troublesome to deal with, not only on account of the difficulty in gaining access to the tumour, but also because the proximity of the growth to the angle of the jaw and the palate makes it necessary to protect these structures from necrosis, and efficient protection is not only hard to maintain, but must increase the already existing discomfort of the patient. Since these growths tend to spread to the pharyngeal portion of the tongue, the most careful examination must be made lest the extent of the disease be underestimated.

TECHNIQUE.

Preparation.—As a preliminary to radium therapy the most scrupulous toilet of the mouth is essential. All carious teeth are extracted; tartar is scraped; gold bridges or large metal fillings must be sacrificed; frequent mouth-washes are employed till the gums are healed and infection is eliminated as far as possible.

It is our custom to treat *the primary growth* first, and then *the glands*: they are never treated at the same time.

1. THE PRIMARY GROWTH.

Both lingual nerves are injected with 1 per cent novocain, and if necessary both inferior dental nerves are also anæsthetized. As a rule no general anæsthetic is employed. The growth is examined, and its situation, extent,

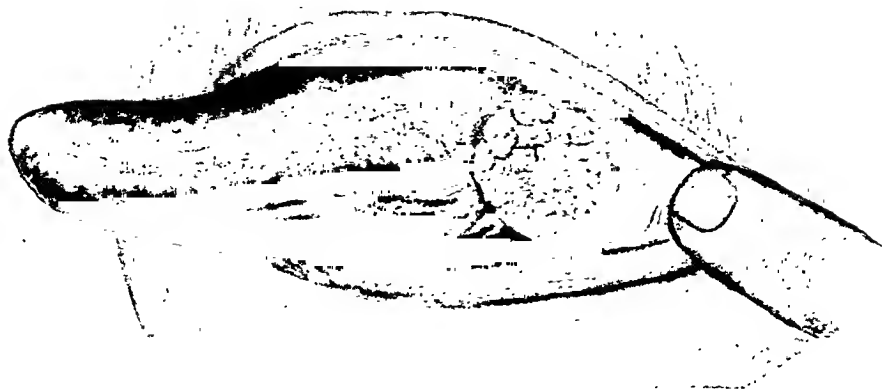


FIG. 26.—Case 1. Before treatment.



FIG. 27.—Case 1. Condition two months after treatment.



FIG. 28.—Case 1. Condition fifteen months after treatment.

and 'volume' are ascertained. The depth of the growth is estimated as far as possible. A stay suture is introduced into the tongue and serves as a retractor; the assistant holds this and he also retracts the cheek. The growth is surrounded by needles which are introduced into the substance of the tongue in the immediate vicinity of the neoplasm. Each needle is threaded with a silk suture and with a piece of fine silver wire. When the radium has been buried, the silk suture threaded on a needle is passed through the substance of the tongue, tied, and cut short. The silver wire protrudes at the angle of the mouth; all the wires are threaded through a narrow rubber tube to protect the lips, and the tube is strapped to the cheek (*Fig. 29*).

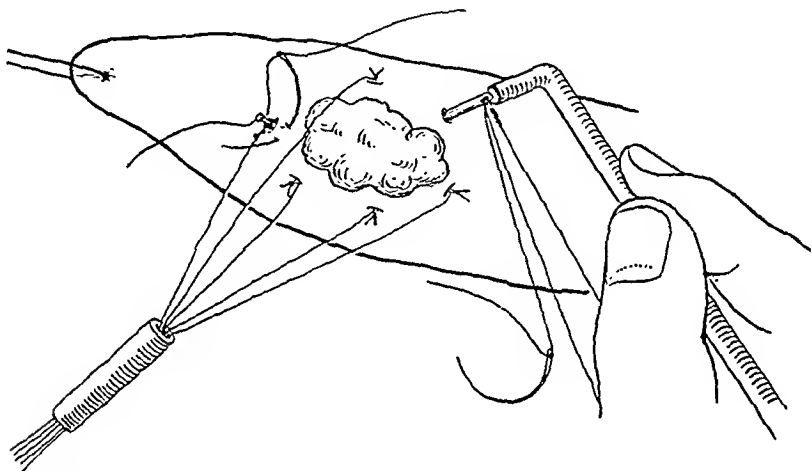


FIG. 29.—Method of introduction of the radium needles. The silk retention sutures are also shown. The silver wires, after the introduction of all the radium needles, are threaded through a rubber tube, longer than that shown in the diagram, and brought out at the angle of the mouth; they are then strapped to the cheek. These wires make it impossible for the radium needles to be swallowed, and facilitate their removal.

Dosage.—Each needle contains radium bromide equivalent to 0.6 mgrm. of radium element; it is 16 mm. long, has a diameter of 1.65 mm. and is screened by 0.5 mm. of platinum. Between 6 and 10 needles are used according to the size of the growth; they are introduced at equal distances from each other into healthy tissue in the immediate vicinity of the growth (*Fig. 29*). They are left in position from 6 to 8 days, the total dosage varying from 600 to 1100 mgrm. hours. This method of calculating is employed as we never use emanations. The points noted are: the number of needles, their size, strength, screenage, and the duration of application. To protect the adjacent bone a simple apparatus is made containing a sheet of lead 1 mm. thick, covered with vulcanite or stent, moulded over the jaw and teeth. This is made specially for each individual case, and the shape and extent of lead protection vary with the position of the growth. For growths situated far back it may be necessary at times to resect subperiosteally the angle and part of the ascending ramus of the mandible, as advocated by L. Ledoux, of Brussels.¹ This resection is done under regional



FIG. 30.—Case 2. Before treatment.

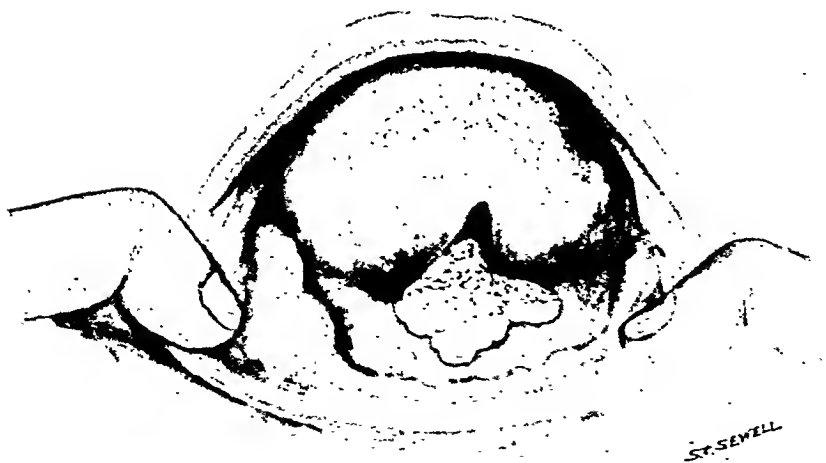


FIG. 31.—Case 2. Showing edema of tongue and slough due to radium necrosis and a half months after treatment.

anæsthesia. It is surprising how little discomfort is caused by this operation and how little it interferes with the movements of the lower jaw.

The patient must be told not to talk; the mouth is irrigated twice daily, and the operation area is occasionally inspected so that any displacement of the needles may be remedied. The introduction of numerous small needles demands patience both on the part of the surgeon and of the patient. The after-treatment is extremely important; the nursing must be entrusted to an intelligent and capable nurse who has been taught the danger of radium burns and of radionecrosis, and the patient must be encouraged to tolerate the apparatus in the mouth. With careful selection of suitable cases, correct dosage, and the right screenage, the disappearance of the primary growth is almost assured.

Mode of Disappearance of the Growth.—The tumour becomes softer and the surface of the growth takes on a whitish appearance, as if it had been painted with pure carbolic acid (*see Fig. 41*). The growth becomes flattened, and the induration which before was one of its striking characteristics disappears. *Figs. 36 and 37* show the changes in appearance on the tenth and thirty-seventh days.

In an ulcerated neoplasm epithelialization takes place from the periphery (*see Figs. 42, 43*), leaving hardly any scarring. On removing the needles the appearance is that shown in *Figs. 36 and 41*. The site of the needle punctures is seen as small necrotic points, and the area treated appears inflamed. The result in successful cases is such that it is difficult within three months to find the site of the original growth (*see Figs. 37, 28, 39*), and the mobility of the tongue returns to normal.

Radionecrosis due to an overdose or the usage of unscreened or insufficiently screened radium is a prolonged process, accompanied by severe pain, marked œdema, and the presence of a slough extremely slow to separate, which is sometimes more exhausting to the patient than the untreated lesion (*see Fig. 31*). It may lead to the disappearance of the growth, but the treatment is most distressing. Between these two extremes of disappearance by shrinkage and epithelialization and that by necrosis there is the whole scale of intermediate stages. With increased knowledge of the action of radium on tissues the optimum dosage in amount, screenage, and duration will be more accurately defined, and radionecrosis should then become a thing of the past.

2. GLANDULAR INVOLVEMENT.

With regard to the treatment of the glandular area, the difficulty consists in deciding which cases are best treated by excision, which by radium therapy, and which by a combination of both. Clinically these cases fall into three groups:—

1. *Frankly Inoperable Cases.*—The glandular involvement is extensive and fixed to the main vascular sheath. As a complete surgical removal is impracticable and partial removal inadvisable, radium treatment alone is given.

2. *Palpable Glands.*—Clinically operable, with no involvement of subcutaneous tissues. Surgical resection is done. It is preferable to do a complete resection on both sides of the neck.

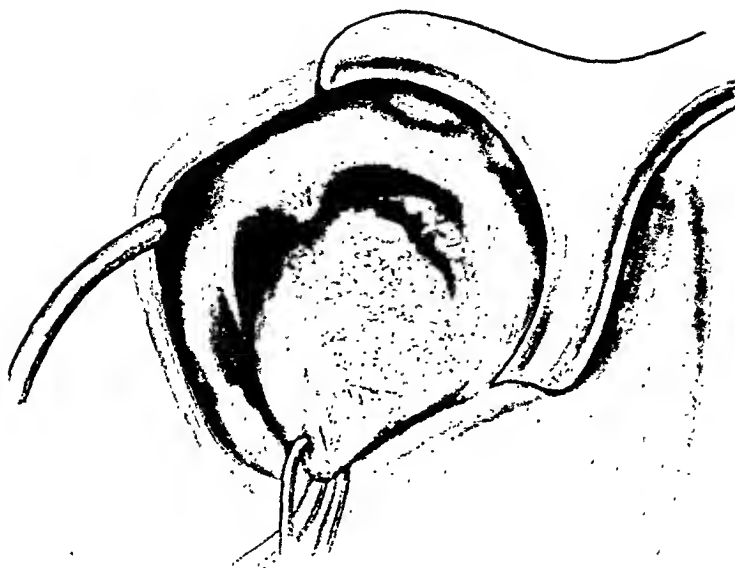


FIG. 32.—Case 3. Before treatment. Hemiglossectomy had been done twelve years previously. Recurrence on the right side.

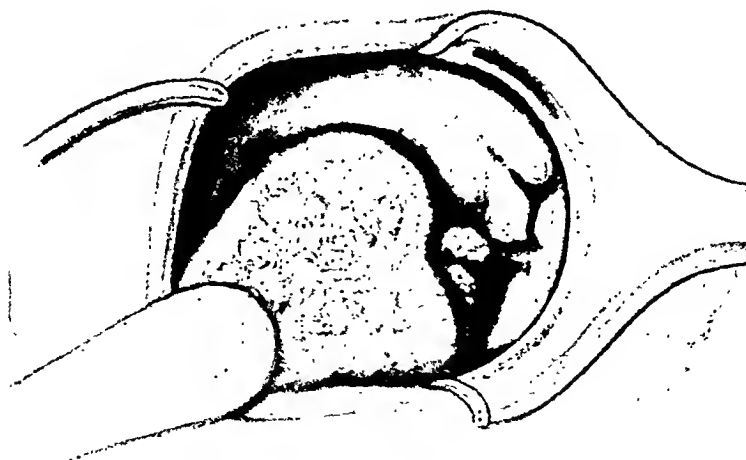


FIG. 33.—Case 3. Condition two months after treatment.

3. *No Palpable Lymphatic Invasion.*—It is in the treatment of cases falling into this group that we are faced with the greatest difficulty. Our knowledge is at present too incomplete to permit us to dogmatize as to the safest method of treatment. We have left some cases untreated, and several months later, though the tongue was normal in appearance, the submaxillary and carotid glands became enlarged (*Cases 1 and 4*), in one case appearing on the side of the neck opposite to that of the primary growth (*Case 6*). Prophylactic irradiation of the neck may prevent this late appearance of the lymphatic involvement, but further experience alone can show if this is preferable to systematic glandular resection of both sides of the neck.

Treatment.—The treatment of lymphatic infection by radium is made entirely by means of distance application. The introduction of needles into the tissues of the neck has been discarded owing to the bad results obtained—

these are due to the impossibility of distributing equal amounts of irradiation in the area of the glandular enlargement. The distance between the radium and the skin is obtained by means of plastic collars (*Fig. 34*). A compound known as Columbia paste is used for this purpose; it was described by O. Monod, A. Esguerra, and G. Richard.² It consists of beeswax, 100 gm.; paraffin (melting at 62° C.), 100 gm.; and fine sawdust, 20 gm. The sawdust greatly diminishes the weight of the apparatus. When properly prepared the paste has one yellow smooth surface and one dark-brown slightly granulated surface. It is important to have the paste of uniform



FIG. 34.—Columbia paste collar with radium needles in brass capsules.

thickness; 15 mm. is a useful working thickness. As the paste contains no metallic substance, no secondary β rays are to be feared. Further, it has been proved at the Radium Institute in Paris that this medium produces a homogeneous irradiation and a diffuse superficial distribution of the rays.² This is demonstrated by the fact that when the apparatus is removed at the end of the treatment, if a dose sufficient to produce an erythema of the skin has been given, the erythema is situated, not corresponding to the disposition of the several needles, but over the exact area in contact with the paste. The patch of pigmentation which follows a few weeks later is also the size and outline of the paste.

Heated at 48° C. the paste becomes soft and malleable but not brittle; it can be handled with ease and suitable pieces cut out; these are accurately

FIG. 35.—*Case 4.*
Before treatment. The patient also had an epithelioma of the pillar of the fauces, shown in *Fig. 38.*

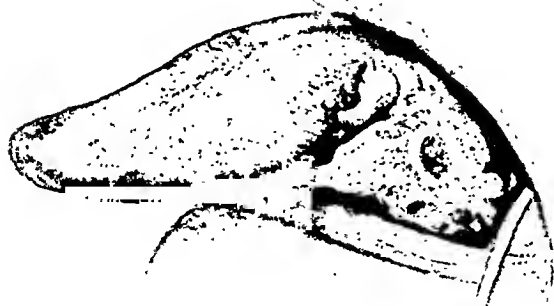


FIG. 36.—*Case 4.*
Condition on the tenth day.



FIG. 37.—*Case 4.*
Condition five weeks after treatment.

moulded over the neck either directly or on to a previously prepared plaster model. The sawdust surface is placed nearest to the skin. The model is then immersed in cold water and hardens rapidly. The next step is the disposition of the radium tubes or needles in the previously prepared wax collar. This is done by gently heating each tube or needle by passing it through a flame and applying it on the external, smooth yellow surface of the apparatus.

For the prophylactic treatment of the neck in cases where no glands are palpable, we use 40 mgrm. of radium equally distributed over the sub-maxillary and carotid areas. By employing 20 needles or tubes of 2 mgrm. of radium element each, screened by 0.65 mm. of platinum and evenly distributed, a uniform irradiation is obtained. The thickness of 15 mm. of paste acts as a further protection. The application is intermittent, the patient receiving 8 hours daily for 10 to 14 days, the total dosage being 3200 to 5400 mgrm. hours.

In cases where the glands are greatly enlarged and inoperable, it is necessary to employ bigger doses—between 60 and 80 mgrm.; a double thickness of paste (30 mm.) is used; the application is continuous day and night, with a few brief periods of rest, the total dosage being 14,000 to 25,000 mgrm. hours distributed over 10 to 14 days. In these cases the superficial layers of the skin peel off towards the end of the treatment, hair follicles are destroyed, but the skin readily heals, leaving a pigmented scar.

RECORD OF CASES.

The following seventeen cases were all examined histologically and found to be squamous-celled carcinomata. The primary lesion was treated with radium only; the treatment of the cervical glands varied in each case, and the particular method chosen is indicated. The dosages employed in the first three cases were much bigger than what we now consider to be advisable, and were left in position for a short period of time. *Case 2* is an example of radionecrosis due to excessive dosage and insufficient screenage. In all cases except *Case 12* and *Case 3* needles were buried in the tongue. *Case 12*, owing to previous syphilitic infection and the invasion of the whole tongue by the neoplasm, was unsuitable for radium puncture, and was treated by surface application by means of an intrabuccal apparatus.

In 16 out of the total of 17 cases (94 per cent) the primary growth disappeared entirely and nothing abnormal could be detected in the substance of the tongue on palpation.

Case 1.—Mr. A. C. G., age 62. Nodular growth the size of a shilling on the left side of the tongue (*Fig. 26*); no palpable cervical glands. Biopsy: squamous-celled carcinoma.

TREATMENT.—The following amount of radium was inserted: 2 needles at 10 mgrm., 2 needles at 12.5 mgrm., and 1 needle at 25 mgrm. All needles were screened with 0.5 mm. of platinum and left in position 12 hours. Total dose 840 mgrm. hours. The growth disappeared entirely (*Figs. 27, 28*). Six months later an enlarged gland was excised from the left anterior triangle of the neck and proved to be epitheliomatous on histological examination. A prophylactic irradiation with a Columbia paste collar 30 mm. thick carrying 60 mgrm. of radium element (20 needles of 2 mgrm. each, 0.6 mm. of platinum; 4 needles at 5 mgrm. each, 0.5 mm. of platinum) was applied 10 hours daily for 7 days. Total dose 4200 mgrm. hours. The patient remains well up to the time of writing (two years).

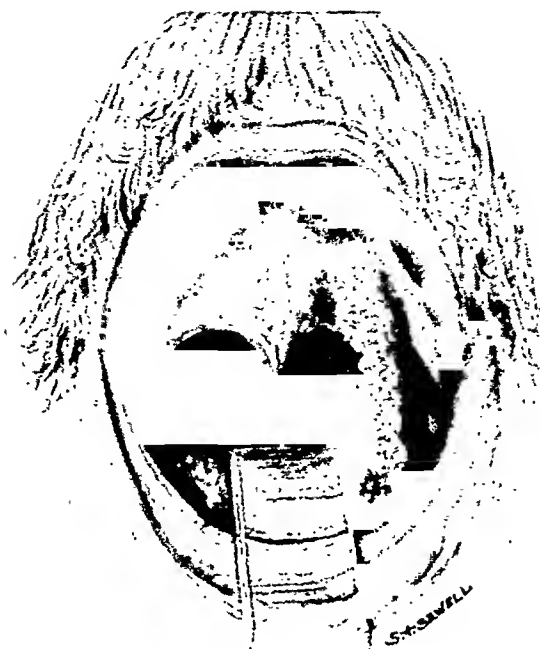


FIG. 38.—Case 4. Epithelioma of pillar of fauces before treatment. Patient also had an epithelioma of the tongue (*Fig. 35*).



FIG. 39.—Case 4. Three weeks after treatment.

Case 2.—Mr. T. C., age 54. Ulcer on the under surface of the tongue and floor of the mouth, the size of a two-shilling piece (*Fig. 30*). The patient was suffering from mitral stenosis and glycosuria. Biopsy: squamous-celled carcinoma. No enlarged cervical glands palpable.

TREATMENT.—The following amount of radium was inserted: 1 needle at 50 mgrm., 1 needle at 25 mgrm., 2 needles at 12.5 mgrm., and 5 needles at 10 mgrm. All needles had 0.5 mm. of platinum screenage. Application 14 hours. Total dose 2100 mgrm. hours. Radionecrosis resulted: marked oedema of tongue, severe pain, extreme discomfort. The growth entirely disappeared and was replaced by a white slough which took three months to separate. The condition at the end of the second month is shown in *Fig. 31*. The patient died of exhaustion at the end of the fourth month.

Case 3.—Mr. E. S., age 68. There had been right hemiglossectomy twelve years previously for epithelioma of the tongue. Recurrence took place in the scar, involving tongue, floor of mouth, and alveolar margin (*Fig. 32*). There were enlarged cervical glands on the right side. Biopsy: squamous-celled carcinoma.

TREATMENT.—Ten needles at 10 mgrm. each of radium element (0.5 mm. of platinum) applied for 10 hours. Total dose 1000 mgrm. hours. This was followed by diminution in the size of the growth, but three months later, as the growth had not entirely disappeared, subperiosteal resection of the angle of the jaw was done previous to a second application of radium. This consisted of 10 needles at 5 mgrm. each (0.5 mm. of platinum) left in position for 33 hours. Total dose 1650 mgrm. hours. The condition of the tumour after treatment is shown in *Fig. 33*.

Case 4.—Mr. E. K., age 62. Nodular tumour the size of a shilling on the left lateral aspect of the tongue (*Fig. 35*), and ulceration of the left pillar of the fauces (*Fig. 38*). No palpable cervical glands. Biopsy of the tongue and pillar of the fauces shows both to be squamous-celled carcinomata. The lingual growth only was treated.

TREATMENT.—Eight needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum) inserted round the growth and left in position for 7 days. Total dose 667.2 mgrm. hours. Complete disappearance of both lingual and faucial neoplasms followed (*Figs. 36, 37, 39*). Six months later an enlarged gland was felt in the left submaxillary triangle. It was irradiated with 50 mgrm. of radium element (20 needles at 2 mgrm., 0.5 mm. of platinum; 2 needles of 5 mgrm., 0.5 mm. of platinum), in position for 10 hours daily for 5 days. Total dose 2500 mgrm. hours. No recurrence up to date.

Case 5.—Mrs. E. L., age 48. Small ulcer on left side of the tongue; no palpable cervical glands. Biopsy: squamous-celled carcinoma.

TREATMENT.—Six needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum screenage) applied for 5 days. Total dose 432 mgrm. hours. Entire disappearance of the growth followed. The patient remained well for ten months, then secondary deposits were found in the left submaxillary and anterior triangles. Excision of glands, which were found histologically to be epitheliomatous. Columbia paste collar (30 mm. thick) with 43.3 mgrm. of radium element in 23 foci (2 needles at 5 mgrm., 0.5 mm. of platinum; 8 needles at 2 mgrm., 0.65 mm. of platinum; 13 needles at 1.33 mgrm., 0.6 mm. of platinum) applied 18 hours daily for 21 days. Total dose 16367.4 mgrm. hours. Marked improvement of neck. Tongue normal.

Case 6.—Mr. F. B., age 65. Ulcer on tip and right border of the tongue (*Fig. 40*); no palpable cervical glands. Biopsy: squamous-celled carcinoma.

TREATMENT.—Ten needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum) applied for 5½ days. Total dose 792 mgrm. hours. Complete disappearance of growth followed (*Figs. 41–43*). Four months later there was a mass of malignant glands in the left submaxillary triangle; these were excised and found histologically to be epitheliomatous.

Case 7.—Mr. A. P., age 61. Papillomatous growth on under surface of the tongue and floor of the mouth (*Fig. 44*). Enlarged cervical glands palpable in the right anterior and submaxillary triangles. Biopsy: squamous-celled carcinoma.



FIG. 40.—Case 6. Before treatment.



FIG. 41.—Case 6. Condition ten days after treatment.



FIG. 42.—Case 6. Condition one month after treatment.



FIG. 43.—Case 6. Condition four months after treatment.

TREATMENT.—Ten needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum screenage) inserted around the growth and left in position 7 days. Total dose 1008 mgrm. hours. Entire disappearance of growth followed (*Figs. 45, 46*). The neck was treated six weeks later by means of a collar carrying 40 mgrm. of radium element in 15 foci, 14 hours daily for 10 days. Total dose 5600 mgrm. hours. Entire disappearance of enlarged glands followed.

Case 8.—Mr. A. S., age 69. Extensive ulceration of the dorsum of the tongue extending deeply into the muscle and involving the whole of the anterior part of the organ. Wassermann reaction positive. Biopsy: squamous-celled carcinoma.

TREATMENT.—As no healthy tissue was available for the introduction of radium needles, these were applied to the surface of the growth by means of a vulcanite apparatus containing a lead lining protecting the upper and lower jaws. Ten needles at 0.6 mgrm. each of radium element (0.5 mm. of platinum), 5 needles at 1.33 mgrm. (0.6 mm. of platinum) applied 3 hours daily for 12 days. Total dose 215.40 mgrm. hours. Owing to the discomfort of the apparatus the patient could not tolerate a more prolonged application. The condition remained stationary.

Case 9.—Mr. F., age 63. Ulcer of the right anterior pillar of the fauces involving the tongue; no palpable cervical glands. Biopsy: squamous-celled carcinoma.

TREATMENT.—Six needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum) applied for 7 days. Total dose 600 mgrm. hours. Disappearance of primary growth followed. Secondary deposits in neck resected by Crile's method three months later. Death from cerebral thrombosis.

Case 10.—Mr. G. F. L., age 54. Extensive ulceration of right posterolateral aspect of the tongue involving the pillar of the fauces; large mass of secondary deposits in neck. Biopsy: squamous-celled carcinoma.

TREATMENT.—Crile's dissection of right side of the neck. Subperiosteal resection of ascending ramus of the lower jaw. Insertion of 10 needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum) for 5 days. Total dose 720 mgrm. hours. Death from bronchopneumonia on the ninth day. The tongue at the time of death showed marked diminution in size and changes in consistency of the growth.

Case 11.—Mr. J. C., age 51. Under the care of Mr. E. Rock Carling. Small ulcer on the under surface of the tongue and floor of the mouth: multiple enlarged cervical glands on both sides, but chiefly on the left side. Biopsy: squamous-celled carcinoma.

TREATMENT.—Wide dissection of cervical glands on the left side. (Histologically proved to be malignant.) Six needles of 1.33 mgrm. each of radium element (0.6 mm. of platinum) left in position for 5 days. Total dose 936 mgrm. hours. Complete disappearance of primary lesion followed. Columbia paste collar with 15.7 mgrm. of radium element in 11 foci applied for 5 days. Total dose 188.4 mgrm. hours. The glands on the right side of the neck were dissected six months later and proved on histological examination to be inflammatory. The tongue was normal in appearance.

Case 12.—Mr. H. M., age 56. Under the care of Mr. Tudor Edwards. Ulcer on left lateral border of tongue posteriorly; no palpable glands in neck. Biopsy: squamous-celled carcinoma.

TREATMENT.—Eight needles of 0.6 mgrm. each of radium element and 1 needle of 1.33 mgrm. inserted around growth and left in position for 5 days. Total dose 735.6 mgrm. hours. Complete disappearance of growth followed. Dissection of cervical glands on left side fourteen days later. Histologically there was no evidence of malignancy in the glands.

Case 13.—Mr. G. C., age 74. Epithelioma of left side of the tongue. Secondary deposits in submaxillary glands and anterior triangle. Biopsy: squamous-celled carcinoma.

TREATMENT.—Eight needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum) inserted around the growth for 5 days. Total dose 576 mgrm. hours. Excision of submaxillary glands. Recurrence in carotid glands twelve months later. Columbia paste collar containing 40 mgrm. of radium element in 20 foci applied for 14 days, 10 hours daily. Total dose 5600 mgrm. hours. Neck normal.

FIG. 44.—Case 7.
Before treatment.
Mobility of the tongue
greatly diminished.

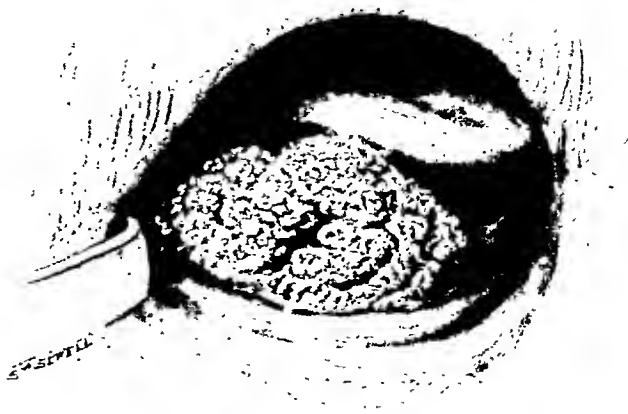


FIG. 45.—Case 7.
One month after treat-
ment.
Mobility of the tongue
returning to normal.



FIG. 46.—Case 7.
Condition three months
after treatment.



Case 14.—Mr. McF., age 69. Ulcer of right pillar of fauces and adjacent portion of the tongue; enlarged cervical glands on both sides of neck. Biopsy: squamous-celled carcinoma.

TREATMENT.—Six needles of 0.6 mgrm. each of radium element for 5 days. Total dose 432 mgrm. hours. Lesion of tongue and fauces completely disappeared. Bilateral Crile's dissection. Histologically malignant glands on right side only. Four months later secondary deposits in the right lung and mediastinum showing very plainly in a skiagram of the chest. No local recurrence in the mouth or neck.

Case 15.—Mr. F. S., age 54. Under the care of Mr. Roek Carling. Syphilitic history. Leucoplakia of the tongue for five years. Wassermann reaction positive. Large ulcer on right side of tongue, involving a quarter of the organ. Enlarged glands on right side of neck. Biopsy: squamous-celled carcinoma.

TREATMENT.—Ten needles of 1.33 mgrm. each of radium element (0.6 mm. of platinum) inserted around growth and left in position 4 days. Total dose 1248 mgrm. hours. Complete disappearance of growth followed. Excision of cervical glands refused by patient.

Case 16.—Mr. G. S., age 68. Fissured ulcer on left side of the tongue posteriorly extending to pillar of the fauces and alveolar margin. No palpable cervical glands. Biopsy: squamous-celled carcinoma.

TREATMENT.—Seven needles of 0.6 mgrm. each of radium element and 1 needle of 1.33 mgrm. inserted for 5 days. Total dose 660 mgrm. hours. Complete disappearance of growth followed. An abscess formed in the anterior triangle about three weeks later, and the pus was evacuated.

Case 17.—Mr. H. H., age 46. Very extensive ulcer on left side of the tongue from tip to pillar of the fauces, involving half the tongue. Wassermann reaction positive. No enlarged cervical glands palpable. Biopsy: squamous-celled carcinoma.

TREATMENT.—Eleven needles of 0.6 mgrm. each of radium element (0.5 mm. of platinum) inserted around growth for 7 days. Total dose 1108 mgrm. hours. The growth has entirely disappeared and the raw surface is gradually healing up.

SUMMARY.

1. The treatment of 17* cases of cancer of the tongue is here reviewed. In each case the clinical diagnosis was confirmed by histological examination.
2. In 16 of these cases the primary growth in the tongue completely disappeared after treatment.
3. No claim is made as to the permanence of the results obtained; the after-history of the patients alone can decide this.
4. The paramount difficulty is the treatment of the glandular area. A combination of surgical excision and radium therapy appears to be the most satisfactory method.

We cannot conclude this short account of some of the first cases treated with radium at Westminster Hospital without gratefully acknowledging the generosity of Mr. Austin Taylor, Chairman of the Hospital, and of the Directors of the Prudential Assurance Co., whose gifts of radium have made this work possible.

* Since this paper was written we have treated three other cases of epithelioma—one at the attachment of the lingual frenum to the floor of the mouth, one of the inside of the cheek, and one of the tongue—in each of which the primary growth has completely disappeared.

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**CARCINOMA OF THE ŒSOPHAGUS: TREATMENT BY
DIATHERMY.**

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PATHOLOGICAL REPORT BY GEOFFREY HADFIELD,

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UNTIL recent years but little had been done in cases of carcinoma of the œsophagus except the performance of a gastrostomy. The introduction of endoscopic methods of examination has gradually led to endoscopic methods of treatment. Carcinoma of the œsophagus is slow in growth, remains for a long time confined to the tube itself, is late to form glandular or metastatic deposits, and, owing to the obstruction produced, can sometimes be diagnosed fairly early. All these factors should make for success in removal, but difficulties of access have hitherto proved almost insurmountable. Until actual removal of the growth by open operation becomes the established method—if, indeed, it ever does—palliative methods must usually be employed. The simple performance of a gastrostomy leaves the individual in such a wretched condition that methods which aim at maintaining the patency of the œsophagus should, if possible, be perfected. Simple dilatation and intubation of the stricture, preferably with the metal tube introduced by Souttar, does do something to prolong life in a reasonable degree of comfort. The application of radium to the stricture is frequently successful in producing alleviation, but cures have not been obtained by most operators.

The very great utility of diathermy in the destruction of malignant growths in the mouth and pharynx—in which regions it has very largely supplanted the knife—has led me to try to adapt its use to malignant disease of the œsophagus. The problem for solution is very largely one of technique, and, after using the method here described for over two years, I feel justified in encouraging others to try it. While I cannot claim any cures, I am satisfied that, by the use of diathermy, one can usually prolong life and maintain a foodway, without any undue risk or suffering as a result of the operation. The use of diathermy, also, does not debar intubation; but if a tube is employed, it should not be inserted until the sloughs have separated—that is, for about ten days after operation. One advantage of diathermy over radium lies in the fact that the whole operation can be carried out in a few minutes. While cases are met with in which only one portion of the circumference of the tube is involved by the growth, in a very great majority this is not so. For the employment of diathermy in the œsophagus, a reasonable degree of proficiency in the use of the œsophagoscope is necessary.

TECHNIQUE.

General anaesthesia with chloroform is employed, with a preliminary injection of hyoseine and atropine. Twenty minutes before the operation, the patient is given 20 min. of adrenalin diluted with $\frac{1}{2}$ oz. of water to swallow.

This diminishes the tendency to hæmorrhage on touching the growth. It is helpful to use as large an œsophagoscope as possible. I employ two Mosher's oval tubes, of 2 cm. diameter, and 27 cm. and 45 cm. in length respectively. Suction, through a narrow tube attached to a suction apparatus and inserted down the œsophagoscope as required, is a great help, being much more rapid in action and producing less trauma than the use of mops. The special electrode employed (*Fig. 47*) is based on the bougies designed by Chevalier Jackson for use through the œsophagoscope. It consists essentially of an insulated shaft and handle, to the end of which various terminals can be screwed. For convenience I employ two shafts of 52 cm. and 70 cm. in length, the former for use with growths in the upper half, through the shorter œsophagoscope, and the latter for those in the lower half, through the longer tube. The terminals for screwing to the shaft consist of: (1) A disc 7 mm. in diameter; (2) A small spike; and (3) A gum-elastic bougie end, with, at its base, a conical metal ring which forms the actual terminal. A disc of heat-resisting composition is inserted between the metal terminal and the bougie end to prevent damage to the latter. This bougie electrode is made in three sizes, of 10, 15, and 20 French catheter gauge. A light cable facilitates manipulation.

In the rare cases seen early, in which a nodule of growth involves one portion of the circumference, the disc or needle electrode can be applied to the growth under direct vision. In the very much more frequent cases, in which the whole or greater portion of the circumference of the tube is involved, producing a more or less annular stricture, the problem is a different one. I originally tried, in these cases, to destroy the growth from above downwards, but found that it was difficult, or impossible, to judge when one had reached the lower end of the growth, thereby introducing a risk either of not doing enough, or, on the other hand, of sloughing normal œsophagus below the growth. This led me to devise this special type of electrode. It is passed through the stricture under direct vision, and then drawn upwards until it meets with the resistance of the lower end of the growth (*Fig. 48*). The current is then switched on, and continuous traction is made on the instrument until it cuts its way out and comes into view at the

FIG. 47.—Diathermy electrode for use in the œsophagus..

FIG. 48.—Electrode passed below the growth preparatory to treatment.

allowed to pass before deciding as to the result of any one application, and I think that if further applications are made, an interval of one month should be allowed to elapse between them.

In the selection of cases, each must be judged on its merits. Advanced cases, with an extreme degree of wasting, should have a gastrostomy performed, and, should their condition improve sufficiently, diathermy can be used at a later date. It should be remembered, in deciding the fitness of the



FIG. 49.—Extensive fungating carcinoma of the œsophagus sixteen days after the applications of diathermy. The arrows denote the site of the section illustrated in Fig. 50.

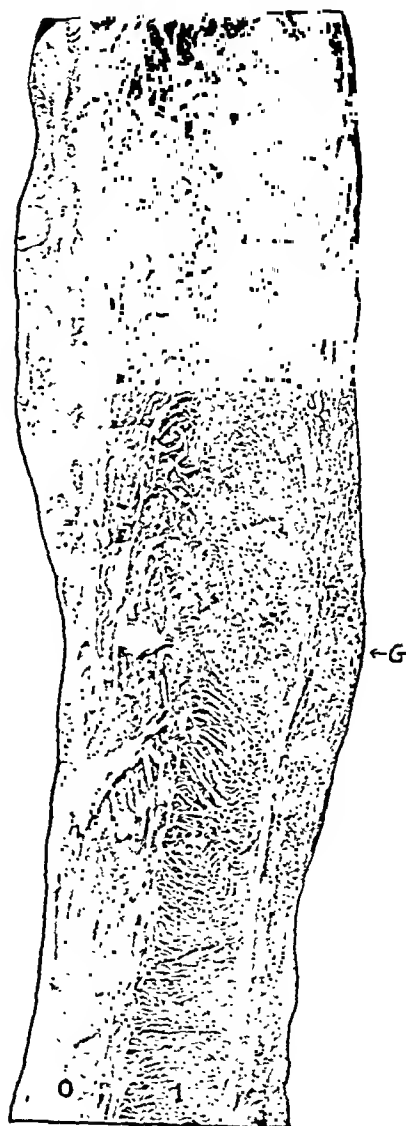


FIG. 50.—Low-power view of a longitudinal section of the œsophageal wall through the floor and edge of the ulcer which followed separation of the slough after diathermy had been applied to a projecting malignant mass. G. Islands of necrotic growth; 1. Inner muscular tunic; O. Outer muscular tunic.

patient for treatment with diathermy, that the whole operation can usually be carried out in a very few minutes and that the amount of shock produced is extremely slight. My own practice now is to employ diathermy in all cases in which the patient's condition is not desperate.

PATHOLOGICAL REPORT.

The specimen here described and illustrated (*Fig. 49*) shows the condition present seventeen days after a single application of diathermy to an extensive fungating growth in a woman, age 71. Death occurred as a result of sudden

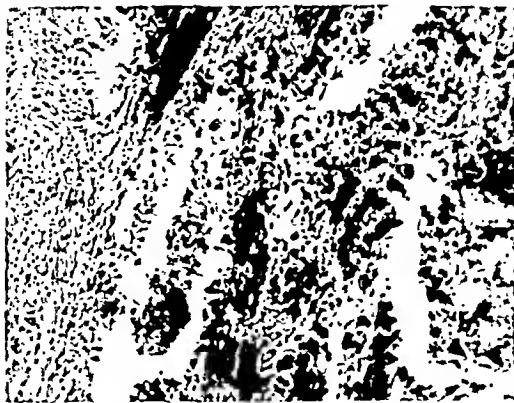


FIG. 51.—Inner muscular tunic below ulcer. Inflammatory reaction to diathermy is here relatively slight.

heart failure, and was not, apparently, in any way due to the diathermy. The pathological report is as follows:—

An irregular area of ulceration was found in the œsophageal wall at the level of the tracheal bifurcation. It was about 3 in. in length and involved $\frac{5}{8}$ of the circumference of the tube. The general level of the surface of the ulcer was that of the mucous membrane above and below it; there was no

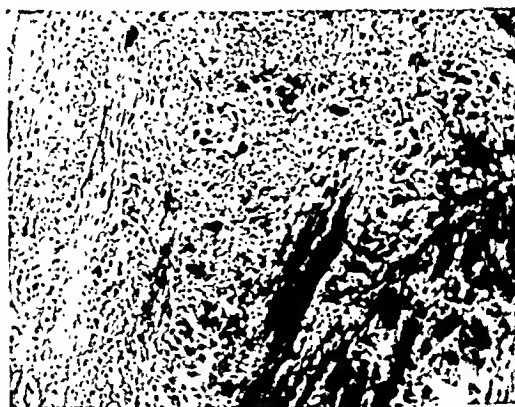


FIG. 52.—Inner layer of muscle below ulcer, showing masses of growth lying in the midst of inflammatory cells, the result of the diathermy.

stenosis. The surface of the ulcer was clean, and, except for three or four low nodules of growth, was red, soft, and spongy, and appeared to be composed of vascular granulation tissue of recent formation. The appearances of

section are illustrated in *Figs. 50-53*. *Fig. 50* is a low-magnification view of about $1\frac{1}{2}$ in. of the œsophageal wall. In its lower third the muscle is intact. In the middle third the inner tunic is indistinct, acutely inflamed, and diffusely infiltrated by growth; *Fig. 52* is from this part of the section. In the upper third both muscle coats are infiltrated and inflamed. The whole of the epithelial and submucous layer is replaced by a thick layer of inflammatory tissue, the result of the application of diathermy, the sloughs having all separated. Over the infiltrated muscle—that is, in the upper two-thirds of the section—the mucous and submucous layers contain many small islands of necrotic growth. Some of these are seen at G in *Fig. 50*, whilst *Fig. 53* is a higher-power view of this layer at G. The scanty growth is seen to be embedded in inflammatory cells. Neither this nor any section showed any growth projecting above the general level of the mucous layer. The diathermy



FIG. 53.—Surface of ulcer. Small islands of necrotic growth lying in the midst of inflammatory cells.

has thus destroyed the mass of growth seen during life projecting into the lumen of the tube. Its effect on the muscle underlying the growth has been to cause a widespread inflammatory reaction, but whilst in some places the growth infiltrating the muscle is little affected (*Fig. 51*), in others it is almost 'snowed under' by inflammatory cells (*Fig. 52*).

SUMMARY.

By the technique here described it is possible to employ diathermy in malignant disease of the œsophagus without undue risk, and with, at any rate, alleviation of symptoms.

TREATMENT OF CARCINOMA OF THE ŒSOPHAGUS: BASED ON 100 PERSONAL CASES AND 18 POST-MORTEM REPORTS.

BY H. S. SOUTTAR,
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THE Œsophagus is one of the common sites for the development of cancer, about 4 per cent of the cases of malignant disease, being situated in this region. In the decade 1911-20 there were reported in England and Wales 15,909 deaths from carcinoma of the Œsophagus, of which 12,059 were males. The annual mortality from the disease in this country is thus roughly 1600, of whom 1200 are males and 400 are females. It must then be admitted that the problem of its treatment is one of considerable importance, and this importance is increased by the lingering and miserable death from starvation to which, apart from surgical relief, these unfortunate people are condemned. The fact that the disease is invariably fatal is to some extent discounted by the advanced age at which it appears. But starvation is just as miserable an end at 70 as at 20.

Upon the pathological course of the disease and upon the best line of treatment the most varied opinions have been expressed. Some, impressed by the general absence of metastatic deposits, declare it to be of low malignancy and essentially suitable for attempts at radical removal, and one enthusiast has recently suggested that this might prove to be possible in 50 per cent of the cases. Others regard gastrostomy as a panacea, whilst others again, amongst whom may usually be numbered the patient himself and his friends, regard it as an invention of the devil. Under these circumstances it seemed to me worth while to undertake a fresh investigation of the problem from the strictly practical point of view of what could be done for the patient, and in the last few years my experiences have led me to certain very definite conclusions and to the adoption of an entirely new line of treatment. To state these conclusions without the evidence on which they are based would serve no useful purpose; but I shall discuss this evidence as briefly as possible, and then pass on to a more detailed description of the treatment I now adopt, together with the results so far obtained.

ETIOLOGY.

In its incidence carcinoma of the Œsophagus presents important peculiarities as regards sex, age, and site. (*See Tables I-III and Figs. 54, 55.*) It occurs four times as frequently in men as in women, but in the two sexes there is a remarkable contrast in the age and the site of its occurrence. In men it is a disease of later life, 96 per cent of the cases occurring after 45, and 88 per cent after 50, whilst the maximum incidence lies between 65 and 70. In women the incidence between 40 and 75 is about constant, whilst no

fewer than 8 per cent of the cases occur before 40. The difference is at least partly accounted for by the greater frequency of post-cricoid carcinoma in women, in whom it would seem to be related to a nervous spasm of the pharynx to which they are more liable than are men.

Table I.—DEATHS FROM CARCINOMA OF ŒSOPHAGUS FOR TEN YEARS 1911-20 : ENGLAND AND WALES.

| | UNDER 40 | 40 45 | 45 50 | 50 55 | 55 60 | 60 65 | 65 70 | 70 75 | 75 80 | OVER 80 | TOTALS |
|-----------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|------------|--------|
| Male .. | 124 | 375 | 972 | 1680 | 2146 | 2278 | 2058 | 1355 | 723 | 348 | 12,059 |
| Female .. | 289 | 315 | 415 | 464 | 470 | 507 | 464 | 414 | 282 | 230 | 3,850 |

15,909

Table II.—AGE DISTRIBUTION IN OWN SERIES OF CASES.

| | | | | | | | | | | | |
|-----------|---|---|---|----|----|----|----|----|---|---|----|
| Male .. | 0 | 3 | 6 | 11 | 14 | 17 | 15 | 10 | 3 | 1 | 80 |
| Female .. | 0 | 3 | 6 | 0 | 3 | 3 | 2 | 1 | 1 | 1 | 20 |

100

Table III.—SITE OF GROWTH (OWN SERIES OF CASES).

| INCHES FROM TEETH | MALES | FEMALES | MALES | FEMALES |
|-------------------|-------|---------|-------------------|----------|
| Upper (7 | 3 | 3 | Per cent | Per cent |
| 8 | 5 | 3 | 13 | 31 |
| 9 | 2 | 0 | | |
| Middle (10 | 28 | 7 | | |
| 11 | 6 | 2 | | |
| 12 | 10 | 0 | 74 | 53 |
| 13 | 6 | 0 | | |
| 14 | 9 | 1 | | |
| Lower (15 | 3 | 0 | | |
| 16 | 5 | 3 | | |
| 17 | 1 | 0 | 13 | 16 |
| 18 | 1 | 0 | | |
| Total cases | 79 | 19 | + 2 unknown = 100 | |

To this circumstance is also due the greater incidence in women of carcinoma at the upper end of the œsophagus, where it occurs in 60 per cent of cases. In men it more commonly occurs at a lower level, and from large series of cases it would seem to occur at the upper, middle, and lower parts in the ratio of 1 : 2 : 3. In my own series of cases the incidence as regards site would seem to be somewhat different, 75 per cent of the male cases lying at a level of from 10 to 14 in. from the teeth (*Table III*). It must, however, be remembered that these figures refer to observations with the œsophagoscope, when only the upper surface of the stricture is seen. As many of the growths were several inches in length, the discrepancy is more apparent than

real. We thus see that carcinoma of the œsophagus is essentially a disease of elderly men, and that more than 80 per cent of the cases occur at or below the bifurcation of the trachea. In my own series in the great majority

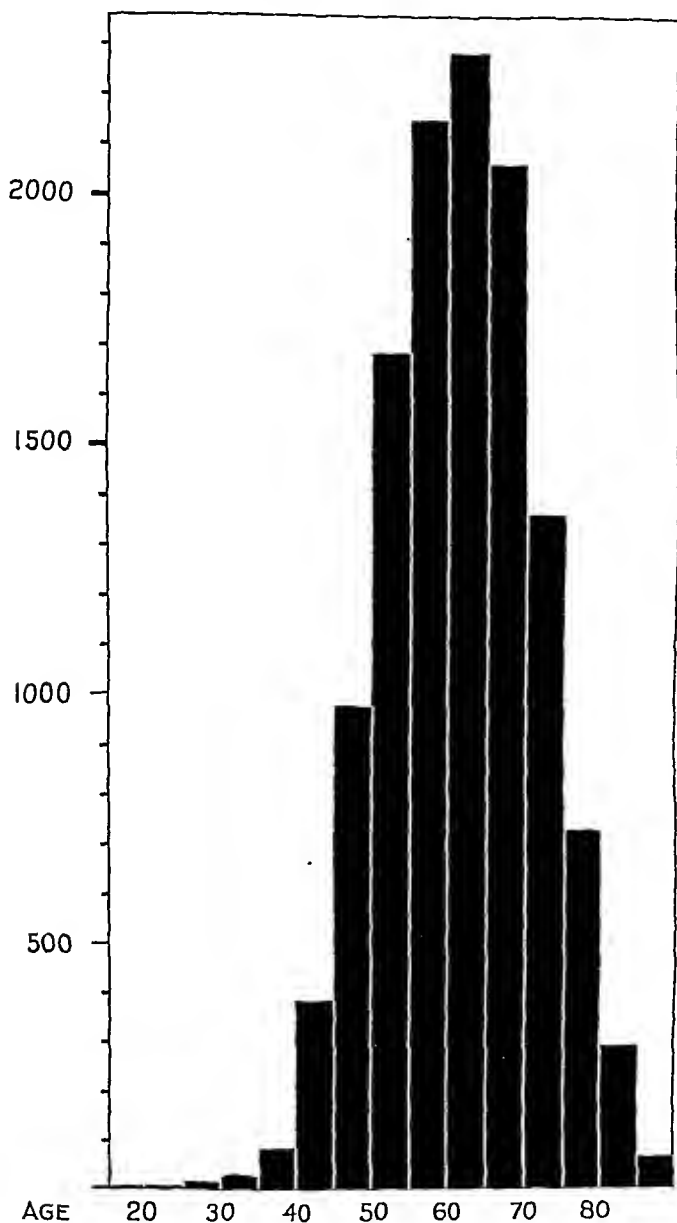


FIG. 54.—Deaths from carcinoma of the œsophagus for ten years—males.

of cases the upper limit of the growth lay approximately at this level—namely, 10 in. from the teeth. In women the disease is much less common,

it occurs more or less uniformly at any age over 40, and the level of its occurrence is more uniformly distributed.

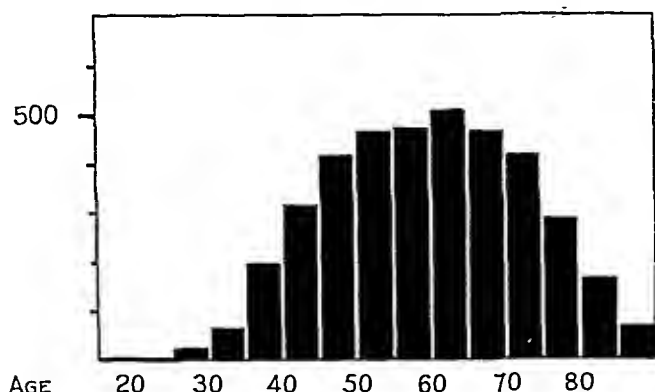


FIG. 55.—Deaths from carcinoma of the œsophagus for ten years—females.

PATHOLOGY.

The most usual histological type of œsophageal carcinoma is squamous epithelioma, remarkable for the number of cell-nests and the degree of keratinization present. A rarer medullary form arises from the glandular structures of the œsophagus, and consists of rounded polygonal cells, often alveolar in arrangement, and of course with no cell-nests. Occasionally a columnar type is seen, usually invading the œsophagus from the stomach but sometimes arising in other situations.

All these varieties of carcinoma spread by the lymphatics and tend to grow round the œsophagus and to produce stenosis. They may, however, remain for a long period localized to one portion of the wall, forming usually a deeply excavated ulcer with raised indurated margins, or a soft, vascular, fungating mass of growth: this is sometimes of great extent, involving in some cases as much as 6 in. of the tube, and even extending down to the greater curvature of the stomach. Though usually single, multiple nodules are sometimes seen, and these are of importance in that they may produce multiple strictures. They indicate extensive lymphatic permeation, since it is from the deep lymphatics and not by superficial spread that they have reached the mucosa.

No one can have examined these tumours post mortem without being struck by their great extent and by the havoc they have worked upon surrounding structures. Several inches of the œsophageal wall may be entirely destroyed, and we have had cases where for a considerable period the patient has swallowed through an intubated mass of carcinoma. Perforation of surrounding structures is naturally common, and the bronchi, pleura, mediastinum, or aorta may be opened up. The commonest termination is perforation of the œsophagus into the respiratory system, with the development of acute bronchopneumonia or of gangrene of the lung.

Secondary deposits occur in the lymph glands along the œsophagus, and

they may extend upwards to the neck or downwards to the epigastrium, giving rise sometimes to large palpable masses. In the neck extensive infiltration may occur and may produce stenosis at this site before the primary growth at a lower level gives any evidence of its presence. Secondary deposits at distant sites are unusual, and of this the local pathology of the growth is a sufficient explanation. Growing in a highly vascular region and surrounded by vital structures, the primary growth destroys the individual before there is any opportunity for the development of secondary deposits.

This is scarcely a picture of a growth of low malignancy lending itself to easy removal, but its accuracy may be judged from the records of post-mortem examinations given below. The objection will be raised that this is a picture of the terminal stage, and that at an early stage it would be very different. The objection is quite valid, but entirely illusory, for the picture drawn accurately represents, in many instances, the stage at which symptoms first appear. Indeed, as will be seen from the records below, carcinoma of the œsophagus may exist in an advanced stage without a single local symptom to indicate its presence. In addition, the appearance seen with the œsophagoscope at the most a few weeks after the onset of symptoms, entirely corroborates the picture I have drawn. No one can have made extensive use of this instrument without often being astounded at the extent of the lesions which are compatible with life, and sometimes even with apparent health. My own experience points to the definite conclusion that carcinoma of the œsophagus is a disease of high malignancy, and that symptoms appear so late that radical removal, except in unique cases, is a pathological impossibility.

The pathological anatomy of carcinoma of the œsophagus cannot be better illustrated than by a series of post-mortem examinations, and for this purpose I have taken 18 consecutive autopsies from the records of the London Hospital between the years 1916 and 1922, for which I would express my grateful thanks to Professor Turnbull. It might be imagined that these were all cases with symptoms of long duration, and indeed it is quite evident from the recorded findings that the disease itself had been present for a long time. As regards symptoms, however, it is a very remarkable fact that the average duration was only 4·7 months, whilst the average duration of symptoms in my own series of cases *at the time of the patient's first appearance* was 4·8 months. It would seem then that I was dealing on the average with cases at a later stage than those which came to post-mortem examination. This was, of course, a statistical accident, but it strongly supports my contention that these post-mortem reports may fairly be taken as the pathological picture, only very slightly overdrawn, of the clinical material with which I had to deal, and it is in this that their great value lies. Terrible though they are, these reports present to us remorselessly accurate pictures to which the true pathology of the living can only be the penultimate stage.

The causes of death in these cases were as follows :—

| | | | |
|---------------------------------|---|-------------------------------------|---|
| Invasion of lung | 4 | Subphrenic abscess and bronchopneu- | |
| Perforation of bronchus | 3 | monia | 1 |
| Perforation of trachea | 3 | Secondary in brain | 1 |
| Perforation of aorta | 1 | Exhaustion and bronchopneumonia .. | 4 |
| Hæmorrhage from growth | 1 | | |

Thus 10 of the 18 cases died from direct involvement of the respiratory tract, and 5 more from its involvement indirectly, making a total of 15, or 83 per cent, who died from pulmonary complications. Of the remainder, 2 died from hæmorrhage and 1 from a secondary deposit in the brain. The last is a rare complication, so that we shall not be far out if we say that out of every 10 cases 9 will die from purulent bronchopneumonia and 1 from hæmorrhage.

POST-MORTEM REPORTS OF 18 CASES.

Case 1.—Edward M., age 55. Six months' increasing dysphagia, regurgitation of solids, increasing pain, wasting. Refused gastrostomy.

POST MORTEM.—A large ulcerated polypoid growth 12 cm. long. It extended from the cardiac orifice upwards along the œsophagus and downwards into the wall of the stomach. A perforation opened into a large abscess cavity below the diaphragm. No secondaries were discovered. Death from bronchopneumonia. Sections showed œsophageal carcinoma of the alveolar medullary type.

Case 2.—Francis C., age 47. Four months' increasing dysphagia. Refused gastrostomy. Died suddenly.

POST MORTEM.—A fungating carcinomatous ulcer, 10 cm. long by 8 cm. in circumference, completely encircled the œsophagus below the bifurcation of the trachea. A large perforation in the commencement of the descending thoracic aorta communicated with the œsophagus. Secondary deposits were found in the adjacent glands, but nowhere else. The stomach and intestines contained very large quantities of blood. Death from hæmorrhage.

Case 3.—Georgina S., age 63. Three months' pain in epigastrium through to back, not related to meals. Stomach tube for test meal passed without difficulty. Died with pulmonary symptoms.

POST MORTEM.—A fungating carcinomatous ulcer, 11 cm. long by 8 cm. in circumference, had almost completely encircled the œsophageal wall below the bifurcation of the trachea. It had invaded the aorta and the mesial aspect of the lower lobe of the right lung. Death from bronchopneumonia.

Case 4.—John C., age 72. For some months increasing dysphagia and wasting. Died two days after gastrostomy.

POST MORTEM.—An ulcerated carcinoma, 5 cm. diameter, with fungating edges, almost entirely encircled the œsophagus at the cardiac opening and involved the stomach. There were secondary growths in the adjacent glands and a small nodule on the lower lobe of the left kidney. Death from bronchopneumonia.

Case 5.—Arthur E., age 46. Ten weeks' increasing dysphagia and three days' absolute obstruction. He died six weeks after a gastrostomy, which had completely closed.

POST MORTEM.—An ulcerated carcinoma, 4.5 cm. long, completely encircled the œsophagus immediately above the bifurcation of the trachea. It involved the upper lobe of the left lung, and a perforation communicated with a large cavity in the left lobe containing food remains. There were no secondary deposits. Sections showed scirrhus epithelioma.

Case 6.—Arthur T., age 61. Four months' bronchitis and dysphagia. On admission very ill with paroxysmal dyspnoea.

POST MORTEM.—A huge carcinomatous ulcer, 13 cm. long, occupied the whole of the œsophagus below the bifurcation of the trachea and extended on to the stomach. It had produced no constriction of the œsophagus, and the growth was nowhere more than 0.7 cm. thick. A large portion of the floor was formed by the pericardium, into which a flat nodule of growth projected. The hilum of the left lung was infiltrated, and there was an abscess at this point. There were no secondary deposits.

Case 7.—Henry T., age 44. Seven weeks before admission he received a heavy blow on the left side of the chest, and soon after vomited up blood. He had since

suffered from increasing dysphagia, and was now unable to swallow. He died two days after gastrostomy.

POST MORTEM.—An ulcerated carcinoma with fungating edge, 8 cm. by 4 cm., encircled the œsophagus below the bifurcation of the trachea. It had involved the left bronchus, into which there was a large perforation. Death from bronchopneumonia.

Case 8.—Edward W., age 45. Six months' increasing dysphagia. Died one month after gastrostomy.

POST MORTEM.—A fungating carcinomatous ulcer, 12 cm. by 8 cm., extended downwards from the tracheal bifurcation, almost completely encircling the œsophagus. A perforation at the middle of the growth led into a cavity in the lower lobe of the right lung, and the pericardium was involved by direct extension. Secondary nodules had invaded the 7th cervical and the 1st dorsal vertebræ, and the œsophagus itself at a higher level. There was a secondary deposit in the left suprarenal. Sections showed a squamous horny carcinoma.

Case 9.—Ernest B., age 57. For six months, cough, rapid wasting, and regurgitation of food. For six weeks swallowed liquids only.

POST MORTEM.—A carcinomatous ulcer, 5 cm. by 1.5 cm., almost encircled the œsophagus below the bifurcation of the trachea. There was a perforation into the left bronchus. Death from bronchopneumonia.

Case 10.—Alfred K., age 56. Three months' loss of appetite, regurgitation of food, and wasting. Died two days after gastrostomy.

POST MORTEM.—An ulcerated carcinoma, 10 cm. long, encircled the œsophagus below the bifurcation of the trachea, extending to the cardiac orifice and producing marked constriction. There were secondary deposits in the glands.

Case 11.—William S., age 49. Seven months' increasing dysphagia, which became complete. He died one month after gastrostomy.

POST MORTEM.—A large carcinomatous ulcer, 6 cm. diameter, encircled the œsophagus just above the cardia. There were secondary deposits in the glands.

Case 12.—Eugenic T., age 48. Eight months' soreness of right side of neck. Four months' dysphagia and cough, with severe dyspnoea and rapid loss of weight.

POST MORTEM.—A carcinomatous ulcer commencing in the right pyriform sinus involved the upper end of the œsophagus. Death from purulent bronchopneumonia. Sections showed squamous carcinoma with large cell-nests.

Case 13.—John D., age 67. Ten weeks' increasing dysphagia, pain in chest, and gross loss of weight.

POST MORTEM.—An ulcerated carcinoma, 7 cm. long, above bifurcation of trachea, with tight constriction. A nodule of carcinoma projected into the lumen of the trachea. Sections showed squamous carcinoma.

Case 14.—Minnie B., age 45. Three months' increasing dysphagia. Death from hæmorrhage.

POST MORTEM.—An ulcerated carcinoma, 5 cm. long, completely encircled the upper œsophagus, extending into the pharynx. Hæmorrhage from œsophagus into stomach. Squamous carcinoma.

Case 15.—John G., age 62. Six months' history of tumour in left centrum ovale. No œsophageal signs. Death in coma.

POST MORTEM.—Carcinomatous ulcer, 7 cm. by 3 cm., in œsophageal wall below tracheal bifurcation. Secondaries in the glands, and large secondary nodules in the centrum ovale, superior vermis, and the left lobe of the cerebellum. Sections showed a polygonal carcinoma with no tendency to the formation of nests. The secondaries in the brain were very vascular, and the destruction of the brain tissue was striking.

Case 16.—John E., age 54. Seven months' increasing dysphagia and rapid wasting. For two months taking food produced violent coughing. Died ten days later after gastrostomy.

POST MORTEM.—Carcinomatous ulcer, 7 cm. long, encircling œsophagus at

upper end. It invaded the posterior wall of the trachea, which was perforated. There were secondary nodules in the glands. Squamous carcinoma with cell-nests.

Case 17.—Thomas M., age 50. Three months' regurgitation of food and wasting. Death with pulmonary symptoms.

POST MORTEM.—Carcinoma, 11 cm. long, completely encircling the œsophagus below the bifurcation of the trachea. The left bronchus was perforated. No secondaries.

Case 18.—Alfred S., age 48. Nine months' increasing dysphagia. For three months, regular dilatation by bougies. Died two days after a sudden attack of dyspnœa with pulmonary signs.

POST MORTEM.—A ragged carcinomatous ulcer, 8 cm. by 3 cm., had destroyed the wall of the œsophagus opposite the bifurcation of the trachea, which was perforated. A large nodule of growth projected into the trachea itself. There were extensive secondaries in the glands. Squamous carcinoma with little nest formation.

SYMPTOMS.

A steadily increasing dysphagia is undoubtedly the primary symptom of œsophageal carcinoma, and where this occurs in a man past middle age there can be little doubt as to the diagnosis. Occasionally the onset is quite abrupt, and the patient is under the impression that a piece of bone has stuck in his throat. His symptoms are probably the result of reflex spasm and may disappear for a time, to reappear as a persistent difficulty in swallowing. Naturally solids are first affected, but in most cases it will be noted quite early that even liquids are checked and only pass down slowly, whilst the regurgitation of unaltered food occurs from the earliest stage. The irritation of the growth produces a secretion of viscid mucus which fills the œsophagus and still further impedes swallowing. Often the patient is entirely unable to swallow in the morning until he has ejected a quantity of white froth, after which he may be able to take food without much difficulty. I have come to regard this white froth as a diagnostic feature. Sometimes it is blood-stained and foul, and it then indicates a fungating growth with extensive ulceration. Occasionally the horrible fœtor indicates gangrene of the lung.

Acute pain, apart from perforation, is a rare symptom, but a dull discomfort referred to the upper sternum is quite common. It is accentuated by swallowing, and it may be very persistent and wearing. Involvement of the dorsal roots may lead to severe intercostal neuralgia, and in one of my cases this appeared as quite an early symptom. Involvement of the recurrent laryngeal nerves may lead to hoarseness and aphonia, and it is important to remember that, if both nerves are involved, bilateral abductor paralysis may result in paroxysms of dyspnœa of the utmost gravity. It is said that persistent hiccup may be an early symptom in a low carcinoma from involvement of the phrenic nerves.

Many important symptoms arise from involvement of the respiratory passages. Irritation produces the secretion of a thick tenacious mucus which may be a source of much annoyance, and which, when swallowed, produces the froth to which we have referred. Invasion of the tracheal wall often occurs, and gives rise at first to respiratory embarrassment from the swelling of the mucosa which results. A nodule of growth may actually perforate the wall and obstruct the lumen, whilst ulceration may lead to a fistulous

communication between the trachea and the œsophagus. When this has occurred, swallowing may give rise to violent fits of coughing, more marked with liquids than with solids, and a septic bronchopneumonia inevitably follows.

Wasting is almost invariable, and is the direct result of starvation. Where ulceration and sepsis are present there may be definite cachexia and anorexia, but many of these patients are ravenously hungry and improve rapidly in condition as soon as they are enabled to swallow. They contrast in a striking manner with cases of carcinoma of the stomach, and it is only in the later stages of exhaustion that they present the shrunken cachectic appearance characteristic of that disease. They are, however, very miserable from their inability to swallow, and thirst, hunger, and sometimes a constant irritating cough rapidly sap their vitality.

EXAMINATION AND TREATMENT.

In examination of these cases we rely on two methods, radiography and œsophagoscopy. By means of the former we can establish the site of the stricture and its organic nature, and in general we can tell whether it is due to malignant disease of the œsophagus or to some other condition. With



FIG. 56.—Carcinoma of the œsophagus. Typical radiographs.

the œsophagoscope we can examine its pathological appearance and investigate its permeability, and in the event of its proving to be permeable by a bougie we can institute treatment.

X-ray Examination.—This should be carried out in two parts, by screen examination and by the study of a film, since the latter gives much more detailed information. The patient stands with the right arm raised above his head, and he is placed somewhat obliquely so that the rays pass either from left dorsal to right ventral or vice versa. In this way the shadow of the heart and great vessels and of the spine are avoided, and a clear picture of the œsophagus itself is obtained. He now swallows a thick emulsion of barium sulphate of the consistency of viscous syrup, and the observer watches on the screen the passage of the emulsion through the œsophagus. It will be seen to reach the obstruction, to fill up the œsophagus above it, and then to trickle slowly through the stricture, which will almost always allow of its slow passage. The appearances with a malignant stricture are absolutely characteristic. There may be a very moderate degree of dilatation above, giving a solid shadow which terminates in a cone pointing downwards, and from the apex of this cone a fine twisted stream of barium can be seen threading the tortuous channel of the growth. Below this the shadow of the normal œsophagus is again observed as the emulsion adheres to its walls. So absolutely characteristic are the appearances that in nine cases out of ten the diagnosis can be established by this means alone. (*Fig. 56.*)

Œsophagoscopy.—This ought to be regarded as a procedure demanding the highest technical skill, for although the expert can avoid trouble, in inexpert hands there is no more dangerous proceeding. It must be remembered that the œsophagus is in any case far more fragile than the intestine,

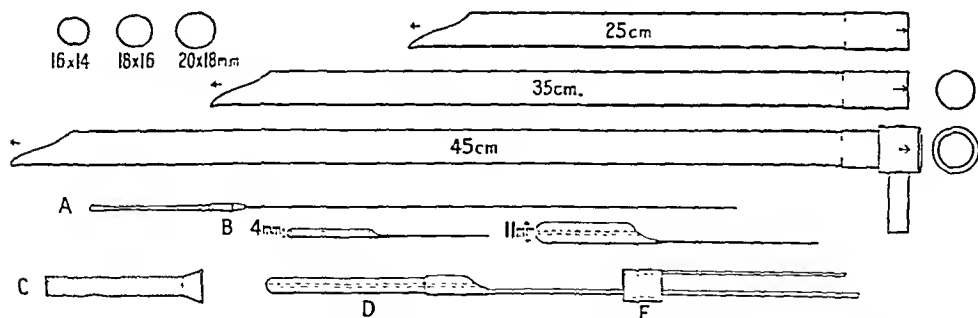


FIG. 57.—Special œsophagoscopes and accessory instruments for intubation. A, Flexible bougie; B, Aluminium dilators, to pass over shaft of A; C, Flexible wire tube; D, E, Introducer and releasing ring.

from the absence of a submucous coat: but we are here dealing with elderly men, and with a tube the walls of which may be deeply ulcerated or may have been replaced by a soft mass of fungating growth. Unless the utmost gentleness is exercised, fatal damage may be done, and even if this is avoided, bleeding may be caused which will so far obscure the view as to render the examination nugatory.

For various reasons I have not found the ordinary instruments suitable

for my purpose, and I have therefore had a special set constructed. It consists of oval tubes of various dimensions fitting interchangeably into the same Brünings handle with a proximal light. The tubes are in three sizes, 20 by 18, 18 by 6, and 16 by 14 mm., outside dimensions, and for each size three lengths, 10, 14, and 18 in., are provided. It is thus always possible to use the largest tube which can be passed on the patient and the shortest which will reach the stricture, so that all procedures are carried out under the best conditions obtainable. (*Fig. 57.*)

Either local or general anæsthesia may be employed. In either case the patient should be given an injection of morphia and atropine half an hour earlier, and just before the operation the epiglottis and pharynx should be painted repeatedly with 10 per cent cocaine. With these precautions the manipulations required can be carried out with very little inconvenience, and even where a general anæsthetic is given to allay the patient's anxiety, these preliminary measures are of great assistance in abolishing spasm.

With the patient lying flat on his back, the head is extended at the occipito-atlantal joint, but is lifted forward so as to straighten the cervical spine. No greater mistake can be made than forcibly to extend the neck. The head, supported by an assistant, is now slightly deflected to one side, and the operator inserts his instrument at the angle of the mouth, thus

FIG. 58.—A, Case 90. Growth completely encircling œsophagus. Tight stricture. Absolute obstruction. B, Case 90. Tube in place. Functional success immediate. C, Case 81. Soft fungating growth, with secondary nodule at higher level. D, Case 81. After intubation with tube and rubber cone. Note secondary nodule above level of tube. E, Case 87. Tight carcinomatous stricture just below cricoid. F, Case 83. Fungating growth on posterior wall at cardiac orifice. Guide has been passed into stomach.

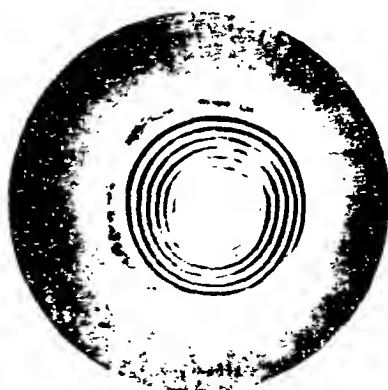
(Drawings by Mr. F. A. Sewell.)

avoiding the prominent central incisors, if they are present, and entering at a point much nearer to the pharynx.

Under the control of vision the epiglottis is now lifted forwards on the beak of the instrument, which enters the pyriform fossa of the opposite side. From this it is deflected to the middle line, where it is probably brought abruptly to rest by spasmodic closure of the cricopharyngeus, the passage of which is the most difficult part of the operation. Gently pressing the tip of his instrument against the sphincter, the operator waits until with a deep inspiration it opens, disclosing the lumen of the cervical œsophagus, into which the instrument glides. After advancing an inch further the wider lumen of the thoracic œsophagus opens up, expanding with each inspiration and closing on expiration to a transverse slit. The assistant now slightly raises the head, and the instrument glides easily through the thoracic œsophagus, following the natural concavity of the thoracic spine. As the lip of the instrument, guided by the vertebral column, again turns forwards, the head, neck, and shoulders must be depressed. The lumen now assumes the appearance of a vertical slit where the œsophagus passes through the diaphragm. At this point extreme care must be taken, for not only is the œsophagus itself here very fragile, but its fixation to the diaphragm renders it peculiarly liable to trauma. Beyond this the cardia will be seen as a puckered opening to which folds of mucosa converge. Entry into the stomach



A



B



C



D



E



F

FIG. 58. Esophagoscopic appearances in carcinoma. For details see p. 86

is announced by a gush of fluid and the appearance of heavy folds of dark-pink mucous membrane.

Where a carcinoma is present the appearances are very characteristic (*Fig. 58*). On entering the œsophagus, its lumen will be seen to be occupied by a thick white, frothy mucus which entirely blocks the view. On advancing farther, variable quantities of liquid and of food remains appear, and if these are excessive the simplest plan for their removal is to tip up the table and to allow them to flow down the instrument by gravity. As the stricture is approached, it will be seen that the walls of the œsophagus, thickened by infiltration, no longer open and close with respiration, whilst slight dilatation of the lumen is usual. The stricture itself may appear as a mere constriction of the mucosa or as a fungating mass of vascular growth which bleeds readily on contact, or we may see a deep ulcer in the œsophageal wall. In any event it must be remembered that all we see is the upper margin of the growth, and that from the appearances alone we can form no idea of its extent.

An attempt must now be made to pass a bougie through the stricture, and for this purpose I use a modification of Jackson's bougie, a flexible sound (*Fig. 57, A*) attached to the end of a steel wire which does not interfere with vision. Under the guidance of the eye the end of the bougie is manipulated until it engages in the lumen of the stricture, though in most cases it will then pass without difficulty. Not the least force must be used, for the wall at this point may be formed by soft growth through which, with the slightest violence, the bougie may penetrate. Once the stricture has been successfully passed, the bougie is pushed on until the wire occupies the stricture and forms a guide over which the dilators may be passed.

These dilators (*Fig. 57, B*) are of a novel type which I devised specially for this purpose. They are formed of short cylindrical rods of aluminium, with an axial hole to slide freely over the wire guide. Each is attached to a long rigid steel wire, and the sizes rise by half millimetres from 4 mm., the smallest, to 11 mm., the largest, in diameter. By passing these in turn completely through the stricture it can usually be dilated with great facility up to the full size. At the same time, as each dilator passes through and clears the constriction, an accurate measurement of its length may be obtained. The method appears to be devoid of risk, but there is one circumstance in which I have always felt it necessary to exercise great caution. If, on dilating a dense stricture offering considerable resistance, it is noted that the resistance has suddenly disappeared, dilatation should proceed no farther, as obviously there is a distinct risk of tearing the œsophageal wall if it is continued.

Mere dilatation will often give great relief, but in most cases the dysphagia soon recurs. To overcome this I devised a tube formed of a coil of German-silver wire, which has proved most satisfactory. A cone-shaped upper end rests on the top of the stricture, and to prevent upward movement the tube is made oval in section and a spiral twist is given to the oval. The success of this last device has been very remarkable, for not a single tube in all my series has been displaced upwards. In soft growths, on the other hand, the whole tube has frequently passed on, dilating the œsophagus to such a degree, however, that in most cases swallowing continued. The tube passes

through the bowel without incident. From its extreme flexibility the tube is readily tolerated, the patient being quite unconscious of its presence, whilst its structure allows of a lumen which can be obtained in no other way. I have never seen any evidence of ulceration of the wall of the œsophagus by the pressure of the tube, and indeed, if properly inserted, its contact with the mucosa is so slight that this is not likely to occur. The tube, in fact, generally tunnels a mass of carcinoma, and in this case ulceration ceases to have its normal meaning. In one of my patients, a man of 69 with a carcinomatous stricture 12 in. from the teeth, a tube remained in place, repeatedly verified by X rays, for eleven months, the patient swallowing well and being entirely ignorant of the existence of the tube.

The method of insertion is as follows. After dilating the stricture as far as is considered safe, a tube of suitable size (*Fig. 57, C*) is selected and is threaded on to an introducer (*Fig. 57, D*). This slides over the guide wire (*Fig. 57, A*), which is still in place, and serves to steer the lower end of the tube through the stricture. The introducer and the guide bougie are now withdrawn through the ring (*Fig. 57, E*), which is then itself withdrawn, and the tube is left in place, its expanded upper end resting on the face of the stricture. The method is applicable to strictures in all situations except the cervical œsophagus, where the irritation of the trachea by the tube prevents its toleration. On several occasions I have passed a tube through a stricture of the cardiac opening into the stomach with a satisfactory result. On the other hand, where a growth is limited to one portion of the œsophageal wall it is useless to insert a tube, as it will be passed at once; these cases, however, are easily relieved by dilatation. (*Figs. 59, 60, 61.*)

Where the tumour is very soft and friable, difficulty may be experienced from the early passage of the tube into the stomach. To avoid this I use a small cone of rubber. This is passed through the œsophagoscope and rests on the top of the growth, and through the cone the wire tube is now passed. The manipulation is by no means easy, but the result is extremely satisfactory, and the method has enabled me to deal with a most difficult class of case. (*Fig. 62.*)

RESULTS.

In the large majority of cases the immediate result of intubation is extremely satisfactory. With few exceptions the patients are able next day to swallow liquids and soft foods with perfect facility. In the case of an emaciated man who has been starved for weeks it is necessary to proceed with caution, but the average patient leaves the hospital two days later having had two poached eggs, fried bread, toast, and coffee for breakfast. As several of my patients had for some days been unable to swallow even the smallest drop of fluid, the change is a very remarkable one, and in most cases the relief lasts for the lifetime of the patient.

In a series of 98 cases I have performed intubation on 50 occasions, and the statistical results are as follows: 7 patients died soon after the operation, but in only two of these was there any reason to suppose that death was due to the manipulations involved. In one of these, a case with extreme emaciation, it was thought that the œsophagus was torn in inserting



FIG. 59.—Tube in carcinomatous stricture.



FIG. 60.—Intubated carcinomatous stricture.
[Passage of barium meal.]



FIG. 61.—Carcinoma of cardiac end.
Long stricture dilated by tube which
actually enters the stomach.

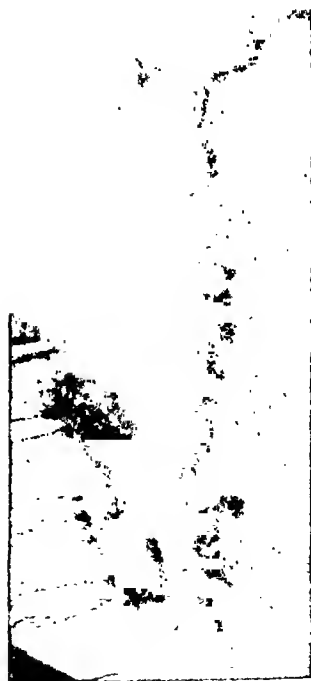


FIG. 62.—Tube in position with rubber
flange.

the tube; in the other the end of the tube had perforated the base of a large carcinomatous ulcer. In the remaining 5 cases, one death was due to exhaustion, one to mediastinal suppuration, one to subphrenic abscess, one to perforation of the lung, and one to perforation and gangrene of the lung. In each case it was ascertained that the cause of death was not the result of the intubation, but occurred in the natural course of the disease. The true operation mortality of this series is therefore 4 per cent, and one may hope to avoid even this by greater experience.

As to the duration of life after intubation or dilatation followed by intubation, in 26 cases followed to a conclusion this varied between 2 weeks and 23 months, the average being 5.3 months. Of the other cases, some have been lost sight of, but many are still alive, in good health after periods up to 7 months. In those who have died, death has resulted from pure exhaustion or from one of the complications to which we have already referred. In some dysphagia recurs, and in these we have on several occasions demonstrated an extension of the growth above the level of the tube. But most of the patients had swallowed satisfactorily till near the end.

As compared with these figures, gastrostomy was performed in 20 cases with 7 deaths, in each case with some complication unconnected with operative technique. The average duration of life of the survivors in 10 cases, followed up was 3.6 months.

Without unduly stressing these figures, I think they prove that intubation is far safer than gastrostomy, and that it affords a longer expectation of life. From the patient's point of view, however, two methods could scarcely be in greater contrast. After gastrostomy he is an invalid, kept alive by artificial feeding and debarred from the exercise of a function without which life is not worth living. After a successful intubation by this method he can eat and drink almost like a normal man, he can enjoy a meal with his family, and there is nothing objective to remind either himself or his family of his disease. I think it reasonable to hope that with further experience such a result will in most cases be obtainable, and it seems to be all that one can ask in a disease which I am firmly convinced is entirely beyond the possibility of surgical cure.

CONCLUSIONS.

This study, based on 100 clinical cases and 18 post-mortem examinations, appears to me to prove quite clearly that carcinoma of the œsophagus is a highly malignant form of growth; that it only fails to produce widespread secondary deposits because it destroys the individual at such an early date; that its earliest symptoms, usually those of obstruction, only appear at a late stage of the disease; and that it therefore neither is nor ever can be amenable to direct surgical attack, except in cases so rare as to be of no practical importance.

It would seem that all we can hope to do is to give the patient relief from dysphagia, and that this is best accomplished by intubation. The method of intubation here described has the advantage that in most cases the patient is able to swallow ordinary food, and in a large number of cases he retains this power until death, which occurs usually from direct involvement of the respiratory tract.

Table IV—TREATMENT AND RESULTS IN 100 CASES OF ESOPHAGEAL CARCINOMA.

| NUMBER | SEX AND AGE | DURATION (Months) | STAGE (Inches from Teeth) | TREATMENT | SURVIVAL (Months) | REMARKS |
|--------|-------------|----------------------|---------------------------------|--------------------------|----------------------|---|
| 1 | F. 50 | 2-5 | 16 | Nil | 3 | Refused gastrostomy |
| 2 | M. 63 | 3 | 14 | Gastrostomy | Died | Bronchopneumonia |
| 3 | F. 43 | 9 | 7 | ditto | 8 | |
| 4 | M. 60 | 3 | 11 | ditto | Died | Hæmorrhage from œsophagus |
| 5 | M. 46 | 3 | 7 | Gastrostomy, tracheotomy | 6 | Emergency tracheotomy. Large mass involving pharynx, larynx, and œsophagus |
| 6 | M. 50 | 3 | 13 | Dilatation | ? | Swallowed fluids easily on discharge |
| 7 | M. 64 | 3 | 12 | Nil | ? | Refused gastrostomy |
| 8 | F. 48 | 8 | 8 | Gastrostomy | Died | Gangrene of lung |
| 9 | M. 79 | 3 | 14 | ditto | 1-5 | |
| 10 | F. 62 | 6 | 16 | ditto | 8 | Recovered swallowing. Gastrostomy allowed to close |
| 11 | F. 61 | 5 | 7 | ditto | Died | Emaciated woman. Pharyngeal carcinoma |
| 12 | F. 45 | 3 | 8 | ditto | 0-5 | Hæmorrhage from œsophagus |
| 13 | F. 74 | 4 | 10 | ditto | ? | Very emaciated |
| 14 | M. 77 | 8 | 10 | ditto | 2 | Not traced. Immediate result satisfactory |
| 15 | M. 62 | 6 | 10 | Dilatation | 5 | Dilated three times |
| 16 | M. 68 | 8 | 16 | ditto | 0-5 | Dilated twice |
| 17 | M. 60 | 6 | 14 | Gastrostomy | 0-5 | |
| 18 | F. 61 | 6 | 10 | Nil | 2 | Refused examination, but diagnosis clinically certain |
| 19 | M. 41 | 12 | 14 | Gastrostomy | 3 | Gangrene of lung |
| 20 | M. 58 | 7 | 10 | ditto | 1 | |
| 21 | M. 48 | 24 | 12 | Dilatation | Died | Mediastinitis. ? injury |
| 22 | M. 61 | 5 | 10 | ditto | 12 | Repeated dilatations |
| 23 | M. 54 | 4 | 10 | ditto | ? | Satisfactory on discharge. Not traced |
| 24 | M. 54 | 4 | 12 | ditto | 23 | Satisfactory on discharge. Not traced |
| 25 | M. 69 | — | 12 | ditto | ? | 'First case of intubation. Intubated after 12 months' dilatation. Tube in place 11 months |
| 26 | M. 67 | 3 | 12 | Dilatation, intubation | 4-5 | |
| 27 | M. 60 | 9 | 15 | Dilatation | ? | Satisfactory on discharge. Not traced |
| 28 | M. 59 | 2 | 10 | ditto | ? | Satisfactory on discharge. Not traced |
| 29 | M. 69 | — | 8 | Intubation | Died | Extension growth involving lower 4 inches of œsophagus |
| 30 | M. 62 | 12 | 14 | ditto | 2 | Tube vomited next day. Replaced satisfactorily |
| 31 | M. 49 | 4 | 17 | ditto | 2 | Tube displaced in violent coughing 3 weeks later. Replaced satisfactorily |
| 32 | M. 64 | 6 | 12 | ditto | ? | Satisfactory on discharge. Not traced |
| 33 | M. 64 | 4-5 | 13 | ditto | ? | Tube vomited next day. Replaced satisfactorily |
| 34 | M. 55 | 10 | 18 | ditto | ? | Tube vomited next day. Replaced satisfactorily |
| 35 | M. 54 | 2-5 | 14 | Intubation | Died | Emaciated man. ? injury to œsophagus |
| 36 | F. 66 | 10 | 11 | ditto | ? | Emaciated woman with dense stricture. Satisfactory, but not traced |
| 37 | M. 64 | 6 | 10 | ditto | 1-5 | Fungating mass of growth. Swallowed well on discharge |
| 38 | M. 66 | 3 | 16 | Dilatation, Intubation | 12 | Dilatation, followed 6 months later by intubation. Very satisfactory |
| 39 | M. 65 | 3-5 | 10 | Intubation | 5 | Died from pulmonary complications. Swallowed well to end |
| 40 | M. 60 | 2 | 11 | Intubation | 14 | Passed tube out and patient recovered. Swallowed well to end. Sudden death. |

| | | | | | | | |
|----|-------|-----|----|-------------|-------------|------|--|
| 43 | M. 71 | 3 | 10 | ditto | Gastrostomy | Died | Hemorrhage from north, which was perforated by carcinoma |
| 44 | M. 57 | 8 | 11 | Intubation | Intubation | 9 | Swallowing very satisfactory |
| 45 | M. 53 | 4 | 10 | ditto | ditto | Died | Large fungating carcinoma. Purulent infection of mediastinum |
| 46 | M. 72 | 1 | 10 | ditto | ditto | 3 | Swallowed well |
| 47 | M. 62 | 3 | 10 | ditto | ditto | 3 | Impassable stricture at upper end of esophagus. Not traced |
| 48 | M. 42 | 3-5 | 7 | Gastrostomy | Gastrostomy | 1+ | Old case cardiospasm. All signs of carcinomatous stricture, but no section |
| 49 | F. 56 | — | 11 | Nil | Nil | 18+ | Large carcinomatous ulcer, possible perforated by tube |
| 50 | M. 60 | 1-5 | 11 | Intubation | Intubation | Died | Tight stricture, 1-5 inches long. First use of aluminium dilators |
| 51 | M. 69 | 2-5 | 10 | Intubation | Intubation | 5 | Cardiac failure during anaesthesia. Post mortem, extensive carcinoma |
| 52 | M. 47 | 3 | 15 | Nil | Nil | Died | of lower end |
| 53 | F. 50 | 4 | 10 | Intubation | Intubation | ? | Satisfactory on discharge. Not traced |
| 54 | F. 67 | 3 | 16 | Nil | Nil | ? | Malignant stricture seen, but impassable. Swallowing fairly. Died |
| 55 | F. 42 | 9 | 7 | Gastrostomy | Gastrostomy | ? | some months later |
| 56 | M. 54 | 11 | 8 | ditto | ditto | 2 | Extensive carcinoma of pharynx and upper esophagus |
| 57 | M. 53 | 9 | 11 | Intubation | Intubation | 1 | Extreme emaciation. Impassable stricture |
| 58 | M. 59 | 6 | 13 | ditto | ditto | 4-5 | Large fungating mass. Tube inserted through rubber cone (first use). |
| 59 | M. 57 | 3 | 9 | Dilatation | Dilatation | 3-5 | Swallowed well |
| 60 | M. 56 | 5 | 10 | Intubation | Intubation | 3 | Nodular growth. Tube with rubber cone |
| 61 | M. 70 | 4 | 14 | ditto | ditto | Died | Nodular growth protruding from lateral wall. Too high for intubation. |
| 62 | F. 60 | 3 | 10 | ditto | ditto | 8 | Sudden death. ? hemorrhage |
| 63 | M. 70 | 12 | 12 | ditto | ditto | Died | Polypoid mass anterior wall. Sections, squamous carcinoma |
| 64 | F. 46 | 4 | 10 | ditto | ditto | 12 | Carcinoma lower end with old perforation into subphrenic abscess |
| 65 | M. 78 | 10 | 16 | Dilatation | Dilatation | 2 | Fragile woman. Very successful |
| 66 | M. 51 | 4 | 10 | Intubation | Intubation | 2 | Bronchopneumonia. Probably perforation of lung a week before |
| 67 | M. 75 | 6 | 13 | ditto | ditto | 0-5 | intubation |
| 68 | M. 62 | 6 | 10 | ditto | ditto | 0-5 | At first very successful, but growth extended above tube, fungating |
| 69 | M. 72 | 2-5 | 8 | Nil | Nil | Died | in upper esophagus |
| 70 | M. 42 | 2-5 | 10 | Dilatation | Dilatation | 2 | Tight constriction. Ulcerated ring of carcinoma |
| 71 | M. 66 | 2 | 10 | Gastrostomy | Gastrostomy | ? | Swallowed well, but troublesome cough. Probably fistula before operation |
| 72 | F. 50 | 6 | 10 | Intubation | Intubation | 9 | At first satisfactory, then intractable vomiting. Extension to stomach |
| 73 | M. 81 | — | 16 | Nil | Nil | — | Swallowed well, but large amount of pus vomited indicated abscess of |
| 74 | M. 52 | 1 | 16 | Gastrostomy | Gastrostomy | 7+ | some standing |
| 75 | M. 61 | 3 | 10 | Intubation | Intubation | 1 | Soft mass of ulcerated growth. Probably perforation |
| 76 | M. 61 | 3 | 13 | ditto | ditto | 4 | Stricture with no apparent ulceration |
| 77 | M. 72 | 2-5 | 10 | Intubation | Intubation | 4 | Large internal nodule projecting into esophagus |
| 78 | M. 71 | 4 | 10 | ditto | ditto | — | Very soft fungating carcinoma |
| 79 | M. 70 | 3 | 10 | ditto | ditto | — | Swallows liquids. Too old for investigation |
| 80 | M. 56 | 3 | 10 | ditto | ditto | — | Hard tumour bulging wall on right. Possibly extra-esophageal |
| 81 | M. 61 | 3 | 9 | ditto | ditto | — | Swallowed well on discharge |
| 82 | M. 72 | 5 | 10 | ditto | ditto | 1 | Attempts failed owing to severe hemorrhage from fungating growth |
| 83 | M. 55 | 3 | 16 | ditto | ditto | 2-5 | Fungating growth beyond tight stricture. Tube passed post mortem |
| 84 | M. 59 | 4 | 10 | ditto | ditto | — | Dense ring carcinoma. Flanged tube very successful |
| | | | | | | — | Dense ring of fungating carcinoma. Very successful |
| | | | | | | — | Ulcerated ring of carcinoma |
| | | | | | | — | Temporary success, but gangrene of lung (noted at operation) |
| | | | | | | — | Immediate success complete. Passed tube post mortem, but continued |
| | | | | | | — | to swallow well |
| | | | | | | — | Tube entered stomach, but remained in position. Swallowed well |
| | | | | | | — | Ulcerated growths. Satisfactory |

Continued on next page

Table IV.—TREATMENT AND RESULTS OF 100 CASES OF ŒSOPHAGEAL CARCINOMA—continued.

| NUMBER | SEX AND AGE | DURATION (Months) | SITE (Inches from Teeth) | TREATMENT | SURVIVAL (Months) | REMARKS |
|--------|-------------|----------------------|--------------------------------|-------------|----------------------|--|
| 85 | M. 64 | 5 | 14 | Intubation | — | One month before, gastrostomy elsewhere. Swallowed comfortably after intubation |
| 86 | M. 70 | 12 | 15 | ditto | — | Ulcerated growth 3 inches long |
| 87 | M. 47 | 2 | 8 | ditto | — | Stricture dilated with great difficulty. Tube caused severe irritation. Swallowed well after removal |
| 88 | F. 50 | 2 | 10 | ditto | 5 + | Very soft growth. Squamous carcinoma |
| 89 | M. 50 | 12 | 13 | ditto | — | Swallowed well on discharge. Ulcerating carcinoma |
| 90 | M. 72 | 8 | 11 | ditto | 2.5 | Swallowed nothing on admission, comfortably on discharge. Complete circle of fungating carcinoma |
| 91 | M. 54 | 7 | 8 | Dilatation | — | Improved. Too high for intubation |
| 92 | M. 69 | 3 | 12 | Nil | — | Impassable stricture, but could swallow fluids |
| 93 | M. 54 | 2 | 10 | Dilatation | — | Soft fungating carcinoma, unsuitable for intubation |
| 94 | M. 59 | 3 | 12 | Intubation | — | Dense stricture. Swallowed well on discharge |
| 95 | M. 73 | 6 | 14 | ditto | — | Tight stricture 3 inches long. Sudden onset. Swallowed well on discharge |
| 96 | F. 87 | 1 | 8 | Nil | — | Impassable stricture |
| 97 | M. 68 | 38 | 7 | Gastrostomy | 10 | Large impenetrable mass. Paralysis both cords. Severe respiratory obstruction |
| 98 | M. 71 | 2 | 12 | Intubation | — | Dense stricture. Swallowing very satisfactory on discharge |
| 99 | M. 61 | 2 | 12 | Nil | — | Large soft fungating carcinoma. Impenetrable, but swallowed fairly |
| 100 | M. 65 | 6 | 10 | Dilatation | — | Soft fungating growth. Unsuitable for intubation. Swallowing improved |

AN OPERATION FOR SLINGING A DROPPED SHOULDER.*

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It is often well for the surgeon dealing with nerve lesions to have an orthopaedic string to his neurological bow. Especially is this the case in a hospital practice where the almost immediate restitution of function is confidently expected by the patient as a result of operation. Nerve suture in this circumstance, with its tedious interlude and uncertain promise, is not always the chosen procedure, and the following is an example of a short cut to function which I believe has not been previously described.

HISTORY.—The patient, a well-developed youth of 17, was referred to me from the Medical Division of Kasr el Aini Hospital by Dr. Yussef Barrada. He had been operated on elsewhere eighteen months before for enlarged glands in the left side of the neck, and he was discharged in a fortnight, as he said himself, "perfectly satisfied". He was in the habit of lifting weights and doing physical exercises, and two months later he felt difficulty in using his left arm. After a few days he noticed that his shoulder-blade was projecting upwards, and that it was sliding to and fro more freely than he thought it should. He also felt a painful drag on his left shoulder. He then consulted a doctor, and was advised to bandage his arm with the elbow supported. This was done for a short period without relief.

ON ADMISSION.—There was a $2\frac{1}{2}$ -in. scar of operation at the upper third of the left sternomastoid, with some induration deep to the scar. The point of the left shoulder was depressed, and the medial angle of the scapula projected prominently at the left side of the neck. The whole trapezius muscle was wasted and did not contract. The sternomastoid was paretic. There was slight winging of the left scapula which the patient could correct.

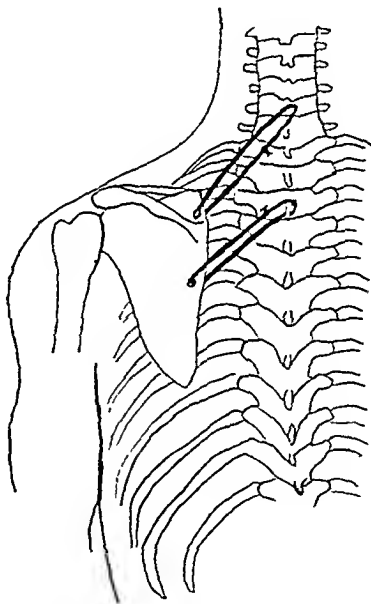


FIG. 63.—The scapula is slung to the spines of the 6th cervical and 3rd dorsal vertebrae by two strips of fascia.

* From the Surgical Unit, Kasr el Aini Hospital, Cairo. Shown at a meeting of the Egyptian Branch of the British Medical Association, Dec. 16, 1926.

Movements.—The patient was unable: (1) To raise his left arm above the horizontal position; (2) To touch the right cheek with his left hand; (3) To put his left hand freely behind his back.

Sensation.—There was blunting of sensations of touch and pain over the distribution of the great auricular and the transverse cutaneous cervical nerves.

OPERATION (Figs. 63, 64).—

Incisions.—Under a general anæsthetic, with the patient lying on his right side and his left arm raised above his head, incisions were made to expose: (1) The medial angle, and (2) The vertebral border of the scapula; (3) The 5th, 6th, and 7th cervical spines, and (4) The 1st, 2nd, and 3rd dorsal spines. Through incisions (1) and (2) the scapula was exposed sufficiently to allow two holes, each $\frac{1}{4}$ in. in diameter, to be bored through the bone $\frac{3}{4}$ in.

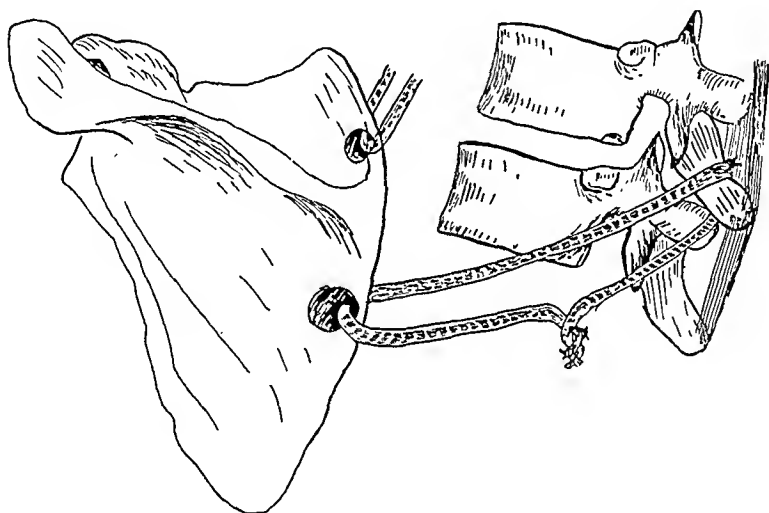


FIG. 64.—The fascial sling is passed through a hole in the scapula and round the base of the spinous process. Its ends are intertwined and sutured, and it is stitched to the interspinous ligaments.

from its margin, one just above the spine, the second $2\frac{1}{2}$ in. below it. Through incisions (3) and (4) the spines of the 6th cervical and 3rd dorsal vertebrae were exposed and their bases stripped of periosteum, care being taken to preserve the interspinous ligaments joining their distal ends.

The Slings.—While these exposures were in progress on the patient's back, a strip of fascia lata 10 in. long and 1 in. wide was outlined through a 12-in. incision on the outer side of the thigh by two longitudinal cuts. The strip was left *in situ* till the work on the back was sufficiently advanced; it was then halved longitudinally, one half being removed and threaded by an end through the hole in the medial angle of the scapula. The other end was passed round the spine of the 6th cervical vertebra *deep* to the interspinous ligaments joining that vertebra to its neighbours. The sling was then drawn as tight as possible and its two ends were intertwined and sutured together with No. 3 catgut. In addition, the loop of the sling which embraced the vertebral

spine was fixed by sutures to the interspinous ligaments. The remaining half of the fascial strip was now detached from the thigh and the procedure was repeated in such a way as to link the second hole in the scapula with the 2nd dorsal spine.

After the closure of the wounds in two layers the left wrist was fixed with a plaster bandage to the head, with the palm of the hand resting on the vertex. There was much difficulty in persuading the patient of the necessity for this posture, and the head bandage had to be supplemented by a plaster support extending from the trunk along the upper limb. He broke this twice, and when, eighteen days after his operation, I saw that he had succeeded in removing the entire fixture, I was prepared to find that our efforts had been defeated. The patient, however, had been testing the operative results for himself, and he was satisfied that there was now no pain in his shoulder, that he could raise his left arm freely above his head, and put it easily behind his back. After some persuasion he consented to remain with his arm bandaged to his head for ten more days, and in return I agreed that the limb should be set free each night when he had lain down.





FIG. 65.—The patient after operation with his arm by his side. (The skin is chalked to show the positions of the two slings.)



Three months after operation I had the opportunity of showing the patient to the Egyptian Branch of the British Medical Association. The shoulder was painless, movements of the left upper limb were free and complete (Figs. 65, 66). The patient unconsciously illustrated this by pulling off his shirt over his head. There was bony thickening at the points where the fascial slings passed through the scapula, and the slings themselves could be felt under the wasted trapezius as thick cords which stood out and became tense when the arm was raised above the head. During this movement, after the deltoid had brought the arm to the horizontal position, the slings steadied and supported the scapula in such

FIG. 66.—The patient with his arm elevated.

a way as to allow the serratus magnus (*serratus anterior*, B.N.A.) to bring

the lower angle of the scapula forwards and outwards and so complete the elevation of the arm to the vertical position.

SUMMARY.

A method is described by which a case of shoulder-drop was successfully treated by slinging the scapula to the spines of the 6th cervical and 3rd dorsal vertebrae by means of 10 in. by $\frac{1}{2}$ in. fascial strips taken from the thigh.

My thanks are due to Drs. Handousa and Hafez for their assistance at the operation, to Dr. Shafik Abd el Malek for his careful notes of the case, and to Dr. Boris Boulgakow for his diagrams. The photographs were most kindly taken by Prof. R. Heatheote.

**POLYPI OF THE INTESTINE :
WITH SPECIAL REFERENCE TO THE ADENOMATA.***

BY JAMES HAROLD SAINT, NEWCASTLE-UPON-TYNE.

SOME confusion seems to exist in the literature as to the exact meaning of the term 'polypus of the intestine', some authors being inclined to regard it as designating a particular type of tumour, which, however, is never well differentiated from adenoma or inflammatory hyperplasia; but on the whole it would seem that it is more commonly, and rightly, used in a broader sense as the general term for any pedunculated or sessile growth projecting into the lumen of the bowel, either the result of hypertrophy or hyperplasia of the mucous membrane, or else a benign, true tumour. It is the latter conception of the term which the writer accepts and applies in this paper.

The intestinal wall is made up of various types of tissue, viz., the mucous membrane, areolar tissue forming the submucous and subperitoneal layers, the unstriated fibres of the musculature, vascular tissue, and the outermost endothelial peritoneal coat. From these various tissues tumours of different varieties may arise, and, enlarging, project into the lumen of the bowel to form polypi. Thus it is possible to find adenomata and papillomata arising from the mucous membrane: fibromata, lipomata, and myxomata from the areolar tissue (though only very rarely from that of the subperitoneal layer); myomata from the musculature; and hæmangiomas from the vessels. The peritoneal coat alone appears innocent of any attempt at tumour formation. Thus the term polypus covers a heterogeneous collection of tumours, and it is necessary in using it to be specific from the histological standpoint.

This work was undertaken in order to study the pathology of the various types of polypi met with in the intestine, the relative frequency of their occurrence, and their favourite sites of predilection. The specimens were obtained from autopsies, and represent a series collected at the Mayo Clinic over a period of several years.

Polypi have been found in all parts of the intestine, but are met with in certain positions more often than in others. They may be single or multiple, and vary very much in size. In 13 of the cases the polypi were met with in the small intestine, the remaining 44 being found in the large bowel.

POLYPI OF THE SMALL INTESTINE.

The following tables show the distribution and types of the polypi met with in the small intestine in this series of cases.

* This work was carried out under the direction of Dr. H. E. Robertson of the Section on Pathologic Anatomy, Mayo Clinic, Rochester, Minnesota, U.S.A., the writer being a Fellow in Surgery on the Mayo Foundation.

Table I.—DISTRIBUTION.

| | | | |
|----------|----|----|----|
| Duodenum | .. | .. | 1 |
| Jejunum | .. | .. | 2 |
| Ileum | .. | .. | 10 |

Table II.—TYPES OF POLYPI.

| | | |
|-----------------------|----|---|
| Glandular hyperplasia | .. | 9 |
| Hæmangioma | .. | 1 |
| Globocellularis | .. | 1 |
| Lipoma | .. | 1 |
| Adenoma | .. | 1 |

Glandular Hyperplasia.—From these tables it is seen that the ileum is the favourite site for polyp in the small intestine, and that, as regards type,



FIG. 67.—Multiple polypi of small intestine. Glandular hyperplasia.

those formed by glandular hyperplasia easily outnumber the other varieties. This type takes the form of multiple excrescences on an average about 1 mm. in diameter, arising from the mucous membrane (*Fig. 67*). They may be either sessile or pedunculated, in the latter case the pedicles being usually not

FIG. 68.—Section of specimen shown in *Fig. 67*. ($\times 18$.)

more than 1 mm. or 2 mm. in length, and most of them are seen to arise from the crests of the valvulæ conniventes. On microscopic examination the polypoid appearance is seen to be due to a rising up of this mucous membrane and submucosa above the general level on to the lumen of the intestine (*Fig. 68*). The villi and glandular follicles between them are similar in appearance to those between the excrescences, so that the condition is apparently merely one of local hyperplasia. In a few instances, forming the pedicle of the polypus, is a mass of lymphoid tissue. This has

a fine connective-tissue stroma derived from the branching of that of the pedicle, and a few thin-walled capillaries can also be seen. It would seem that these polypi are formed by a hyperplasia of some of the lymphoid follicles in the intestinal mucosa, as these ordinarily do not project into the lumen of the bowel to such a marked degree. Kanthack and Furnival in

their case found similar glandular hyperplasia with normal lymphoid follicles occurring chiefly in the duodenum and jejunum; but in the present series 8 out of 9 cases were found in the ileum and the remaining 1 in the jejunum.

Hæmangiomata.—Hæmangiomata of the intestinal wall are rare, though more common in the small than in the large intestine. MacCallum in 1906 published a case of multiple cavernous hæmangiomata occurring throughout the length of the small intestine, but especially in its upper portion. At that time he was able to find only four other recorded cases, two of which were single and two multiple. The present case conformed to the most common macroscopic characteristics in that the hæmangiomata were small and multiple. They were found only in the jejunum. The larger tumours, about $\frac{1}{2}$ cm. in diameter, pushing the mucous membrane before them, appeared as reddish nodules in the lumen of the intestine, and could also be seen shining through the peritoneal coat as dark-purplish patches. By transmitted light, a large number of these dark areas, varying in size from $\frac{1}{2}$ cm. to 1 mm., were seen situated on the course of veins. At first the nodules were thought to be



FIG. 69.—Section through hæmangioma of small intestine. ($\times 8$.)

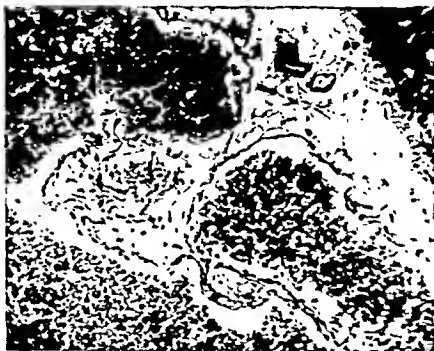


FIG. 70.—Hæmangioma of small intestine, showing endothelial lining of blood sinuses. ($\times 70$.)

simple hæmorrhages, until microscopic examination proved them otherwise. A section through one of them (Fig. 69) shows that it is not a hæmorrhage but a vascular tumour. The submucous layer is greatly increased in thickness, and in it are seen numerous irregular, sinus-like spaces, each of which is lined by a definite layer of endothelium (Fig. 70) and contains blood in greater or less degree. External to the endothelium is the connective tissue of the submucosa, forming partitions between the sinuses, there being no suggestion of vessel-wall formation. In some of the sections the partitions between the blood sinuses are seen to end abruptly in the centre of a space, showing that the sinuses communicate freely with one another, thus proving the cavernous character of the tumour. There was no attempt at encapsulation.

Bennecke described an interesting case in which the cavernous tumours existed throughout the œsophagus and stomach as well as the intestine, and he considers them to resemble the cavernous hæmangiomata of the liver in their general character.

Globocellularis.—Another rare type of tumour found in this series,

forming a small polypus in the ileum, is the globo-cellularis, or carcinoid tumour, as it is sometimes called. It is also referred to as a primary carcinoma. Apparently the two usual sites for this type of tumour are the small intestine and the appendix.

Two of the best contributions to the literature on this subject are those of Bunting, and Rolleston and Jones. Bunting describes a case of "multiple primary carcinomata of the ileum" in which several small nodular structures were scattered throughout the upper part of the ileum. At the same time he quotes the only other six recorded cases he was able to find. All were multiple. He describes their characteristics as the multiplicity of primary foci occurring at other than the usual sites of occurrence of intestinal growths, the undifferentiated nature of the cells, their slight invasive tendency, and apparently slow growth. Krompecher was the first to draw attention to the resemblance between these tumours and the slowly growing basal-celled type of epithelioma.



FIG. 71.—Carcinoid tumour (globo-cellularis) of ileum. ($\times 15$.)

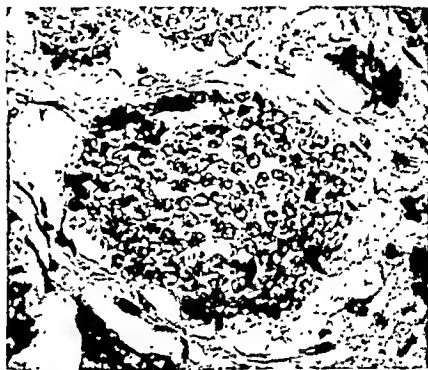


FIG. 72.—Higher magnification of Fig. 71, showing large nuclei and prominent nucleoli. ($\times 240$.)

The 'primary carcinoma' of the appendix described by Rolleston and Jones has macro- and microscopic characteristics similar to these multiple tumours described by Bunting and to the specimen found in this series.

The tumour under review was single, in contrast to Bunting's, sessile, and about 4 mm. in diameter. To the naked eye it looked rather like an adenoma, but was paler in colour. Upon histological examination there were seen numerous nests of closely-packed cells in the submucosa, causing considerable thickening of that layer of the intestine at this point (*Figs. 71, 72.*) Internal to the cell-nests neither villi nor crypts of Lieberkühn were seen, their place being taken by gland-like spaces similar to the cell-nests of the tumour. The latter were varied in size and shape, and were separated from one another by a fairly dense connective-tissue stroma containing in its inner part some smooth muscle fibres derived from the muscularis mucosæ and in which only a few cells were seen. Occasionally cell-nests were seen to be connected with one another by slender columns of cells. The tumour-cells were small and uniform in size, round or almost so in shape, with scanty clear protoplasm, and possessed large vesicular nuclei staining well with basic

dyes and containing prominent nucleoli. Mitotic figures are described as being of rare occurrence, and none was observed in this case. In some of the cell-nests a tendency to the formation of a lumen was seen, the appearance being due to the degeneration of the centre cells. The tumour, though not encapsulated, was limited to the submucosa and exhibited no tendency to penetrate the muscular coat. This type of tumour has given rise to much controversy, and whether or not it can be accurately designated carcinoma seems to be still a debatable point.

Lipomata.—Although lipomata may arise from the submucous coat and grow inwards, or from the subperitoneal coat and project outwards, the

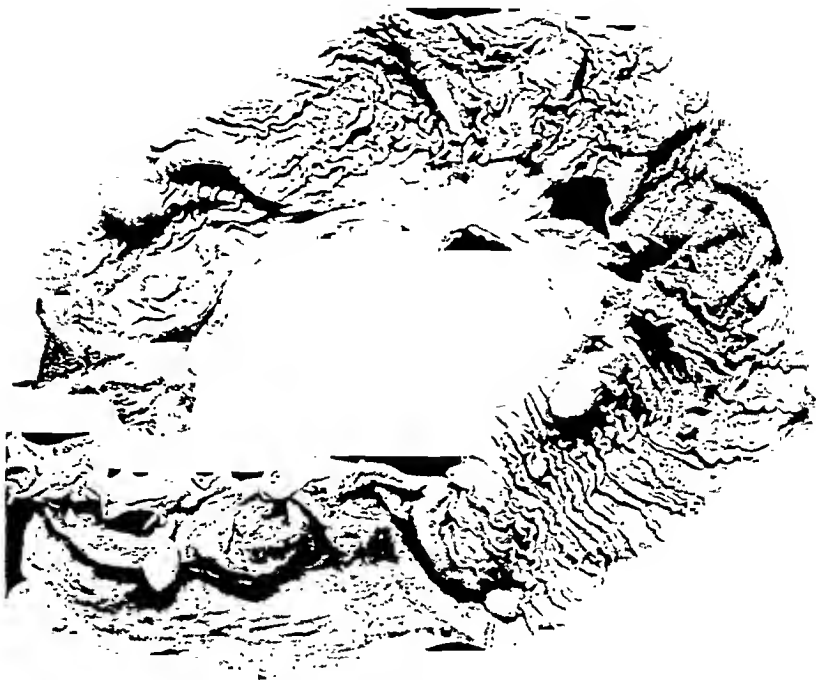


FIG. 73.—Multiple submucous lipomata of ileum.

former is the more common as a site of occurrence of these tumours. Lipomata may occur anywhere in the intestinal tract, may be single or multiple, sessile or pedunculated. Perhaps their only claim to any importance is the large size to which they may grow, finally obstructing the intestine or being instrumental in bringing about the condition of intussusception.

In a case of this series, multiple lipomata were found in the ileum (*Fig. 73*). They were six in number, and varied in size from 1.5 cm. to 0.5 cm. in diameter. All of them were sessile, but one or two were slightly constricted at their bases, indicating the commencement of a pedicle. The mucous membrane covering them appeared tense and smooth, and the fatty tissue shining through it gave to the tumours a yellowish tinge. Microscopically one of these tumours is seen to consist of a circumscribed mass of fat-cells

lying in the submucosa, resting on the muscular coat, and covered by mucous membrane in no wise differing from that lining the bowel.

Adenomatous Polypi.—These are of much less common occurrence in the small than in the large intestine. In the former they are most often met



FIG. 74.—Adenoma of duodenum: probe in ampulla of Vater.

with in the duodenum. It was in this part of the small gut that the only one in this series was found (*Figs. 74, 75*). The polypus was situated about 2 cm. below the duodenal papilla; it measured 1.5 cm. in length, and had a



FIG. 75.—Another view of *Fig. 74*.

diameter of about 0.5 cm. It was pedunculated, its pedicle being 0.5 cm. in length. On microscopic examination the polypus proved to be a typical adenoma, the morphological characteristics of which will be described at some length when polypi of the large intestine come under discussion later.

The following tables show, first, the relation between number and sex, and, secondly, the age incidence, of the cases encountered in this series.

Table III.—NUMBER AND SEX INCIDENCE.

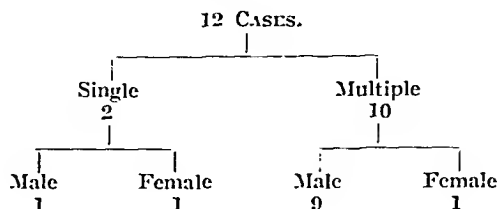


Table IV.—AGE AND SEX INCIDENCE.

| AGE Years | MALE | | FEMALE | |
|--------------|--------|----------|--------|----------|
| | Single | Multiple | Single | Multiple |
| 10-19 | 0 | 1 | 0 | 0 |
| 20-29 | 0 | 3 | 0 | 0 |
| 30-39 | 0 | 1 | 0 | 0 |
| 40-49 | 0 | 2 | 0 | 0 |
| 50-59 | 1 | 1 | 1 | 0 |
| 60-69 | 0 | 1 | 0 | 1 |

From *Table III* it is seen that in the small intestine multiple polypi were of much more frequent occurrence than those which are single.

Table IV presents no outstanding facts from which any conclusions can be drawn. It is interesting that while the first case of multiple polypi (glandular hyperplasia) tabulated above was in a boy of 16, the last was in a woman of 63, showing that the condition can occur at widely differing ages; but whether or not the condition begins early and persists throughout life it is not possible to say. Kanthack and Furnival's specimen was found at autopsy in a girl of 13.

POLYPI OF THE LARGE INTESTINE.

Polypi occur much more frequently in the large than in the small intestine, and may be classified into two groups, namely: (1) Those resulting from inflammatory or ulcerative processes in the bowel; (2) True tumours, of which the only representatives in this series of cases were adenomata and lipomata. The following tables show the types of polypi and their distribution in the various parts of the large bowel:—

Table V.—DISTRIBUTION.

| | |
|---------------------------------|----|
| Cæcum | 8 |
| Ascending colon | 6 |
| Transverse colon | 3 |
| Descending colon | 5 |
| Sigmoid colon | 20 |
| Rectum | 5 |
| Part of colon unspecified | 4 |

Table VI.—TYPES OF POLYPI.

| | |
|--------------------|----|
| Inflammatory | 6 |
| Lipoma | 2 |
| Adenoma | 36 |

Thus the sigmoid was the most frequent site of occurrence of polypi in the large bowel, and adenomata were the type of polypus by far the most frequently met with.

POLYPI ASSOCIATED WITH ULCERATIVE COLITIS.

These are not true tumours, but consist of strips of mucous membrane which have become detached along almost their whole length due to the undermining character of the ulceration. Their number is probably greater in the milder forms of ulceration, since if this is very severe one can imagine a widespread detachment of the mucous membrane, leaving behind only enough to form comparatively few polypi. In the six cases in this series the colitis was in an advanced stage, with thickening and contraction of the colon

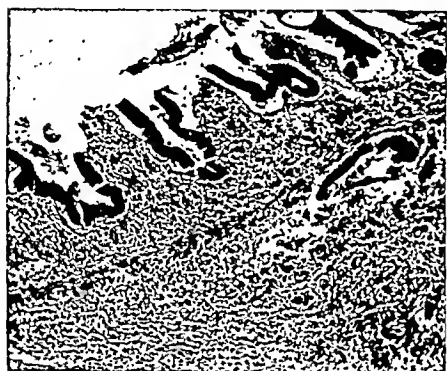


FIG. 76.—Section of inflammatory polypus: dense cellular infiltration of connective tissue. ($\times 36$.)

wall, disappearance of the haustra, and marked denudation of the mucosa, so that the resulting polypi were few in number. In size these polypi vary considerably, but most of them are long and thin, showing little alteration in diameter between their free and attached ends. Microscopically, glandular and connective tissue is seen; the glands have the same appearance as those of the normal mucous membrane, but their relationships have been disturbed, doubtless as a result of the ulcerative process, so that they appear scattered throughout the mass of inflammatory tissue. The connective tissue is considerable in amount, and

is heavily infiltrated with chronic inflammatory cells—lymphocytes, plasma cells, and mast cells (*Fig. 76*).

LIPOMATA.

Lipomata in the large intestine have the same naked-eye and microscopic characteristics as those found in the small bowel. In the first of the two cases of lipomata in this series the tumour was sessile, situated in the caecum, was about $1\frac{1}{2}$ cm. in diameter, and protruded into the lumen for 3 or 4 mm. The lipoma in the second case was a sessile tumour 2 cm. in diameter and about 1 cm. in depth, adjacent to the posterior segment of the ileocaecal valve, while in the caecum three or four small sessile adenomata were present. Lewisohn published an interesting case in which a patient had been suffering from intermittent attacks of intestinal obstruction of short duration and right-sided abdominal pain. At operation a pedunculated lipoma the size of a plum, originating from the inner wall of the ascending colon, and gangrenous in its distal part, was found. Lewisohn thought that the gangrene had evidently been caused by the tumour having been caught in and constricted by the ileocaecal valve at frequent intervals.

ADENOMATA.

The adenomata form a very interesting group of polypi. They may be described as tumours arising from the glandular epithelium in which the epithelium and connective tissue grow co-ordinately. They form the most common type of polypus met with in the large intestine, and as such have interested pathologists for many years, so that the literature concerning them has assumed large proportions. They vary very much in size, and may be single or multiple. In this series their size varied from that of a pinhead up to a diameter of several centimetres. The larger type of adenoma is usually single.

Multiple adenomata may be divided into two distinct types:—

1. The entire colon or a limited portion of it is covered with small pedunculated and sessile polypi in such numbers that the mucosa is almost hidden. This is the type referred to as 'multiple polyposis of the colon' or 'colitis polyposa' by such authors as Virchow, Luschka, Doering, Struthers, and others quoted by them. It would seem that this condition is always associated with an inflammatory or ulcerative process in the colon. Judging from the histological reports in the literature accompanying this type, it is of interest, however, to notice that true adenomatous formation does not necessarily predominate, but that many of the polypi may show only simple glandular hyperplasia. Dilatation of the glands into cyst-like spaces has been observed (Virchow, Luschka, Libert), and to this condition Virchow gave the name 'colitis polyposa cystica'. It is probably an advanced stage of colitis polyposa, and is due to the occlusion of the mouths of secreting glands by the fibroblasts formed during the inflammatory process. This condition was not met with among the cases of the present series, but is mentioned to avoid confusion with the second type, which is also sometimes referred to as 'multiple polyposis'.

2. In this type, which is perhaps best described under the name 'multiple adenomata', the mucosa is studded with these tumours, which, however, are few in number when compared with the myriads found in the first type. They may be either sessile or pedunculated, may grow to a fair size, but are usually not so large as the single adenomata. They are usually seen growing on the free edges of folds of the mucous membrane.

Given below is a detailed description of a typical pedunculated adenoma with a horizontal diameter of 2 mm. and measuring 2.5 mm. proximo-distally, mounted on a pedicle about 1.5 mm. in length (*Fig. 77*).

The tumour is darker in colour than the mucous membrane of the bowel, and its surface is smooth. On small magnification the mouths of the glands

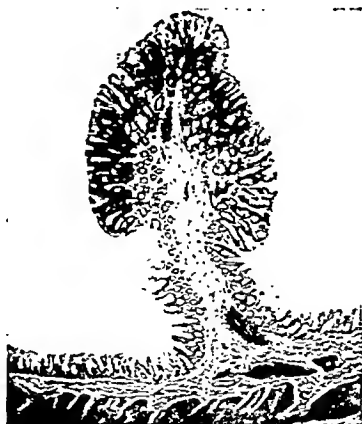


FIG. 77.—Pedunculated adenoma in section. ($\times 8$.)

opening on the surface are seen. The pedicle is smooth and covered with mucous membrane continuous with that of the intestine. It is somewhat cylindrical in shape, but is broader at its base where it is attached to the intestinal wall, its diameter decreasing until the point is reached from which the tumour is appended. On section, the pedicle is seen to consist of a core of connective tissue growing up from the submucosa. On reaching the tumour the core loses its identity by dividing into processes which pass in among the glandular tissue. Microscopically the tumour is seen to consist of glandular and connective tissue, the latter acting as the supporting framework of the former.

The glandular tissue consists of long tubular glands mostly perpendicular to, and opening on, the surface of the tumour. These glands are lined by columnar epithelium. In the neighbourhood of the pedicle the glands resemble those of the normal intestinal mucosa, i.e., they are about the same in diameter and are lined by cells each having a single oval nucleus at its base. The longitudinal axis of the nucleus is parallel to that of the cell. Very little or no cytoplasm is visible, the cells being distended with mucus, and some of this substance is also lying free in the lumen of the gland. Towards the periphery of the tumour the glands change somewhat in character. They enlarge considerably both in length and diameter, and the lining epithelium assumes a different complexion, the cytoplasm having a granular appearance. However, many of the cells are distended with mucus, this clear material standing out prominently in contrast to the granular cytoplasm of adjacent cells. The nuclei are arranged in three or four layers, and some of them occupy a position in the inner part of the cell. In other words, these cells have lost their polarity. Here and there regular mitotic figures are seen in the inner parts of the cell. There are some thickenings of the epithelium appearing as vegetations projecting into the lumina of the glands. These changes are marked with increasing distinctness the more nearly the glands are situated to the periphery of the tumour. It would seem from these changes that the cells of the glands near the pedicle, like those of the mucous membrane, are concerned entirely with the secretion of mucus, whereas those towards the periphery are apparently beginning to be concerned with proliferation, although still retaining their mucus-secreting power.

The interglandular connective tissue consists of branches from that of the pedicle ramifying in the interstices between the glands and forming the supports on which they rest. Towards the periphery the connective tissue forms a fine reticular network, in the meshes of which vessels and cells are seen. The vessels are capillaries which for the most part are filled with red cells. The cells in the network are numerous, and various types are seen:

- (1) Elongated connective-tissue cells with spindle-shaped nuclei. The nearer the pedicle the greater is the tendency of these cells to be closely parallel to one another and so form fasciculi. Towards the periphery their numbers diminish considerably.
- (2) Small round lymphocytes in abundance, being grouped together in various places.
- (3) Large mononuclear cells with a pale clear protoplasm and a darker staining nucleus which has a reticulated structure. These are not nearly so numerous as the small lymphocytes.
- (4) Plasma cells—large protoplasmic cells, each with a round eccentric nucleus

having in it several chromatin granules arranged mostly round the periphery, giving it the appearance of a spoked wheel. (5) Eosinophilic leucocytes. (6) Mast cells with a small nucleus and a cytoplasm which contains large numbers of granules staining deeply with basic dyes. (7) Red blood-cells, present in large numbers in the interstices of the connective tissue.

The pedicle is seen to take origin from the loose areolar submucosa. It is composed of strands of connective tissue running up into the tumour, encased in mucous membrane continuous with that of the intestine. The connective tissue consists of long parallel fibrils which in the centre of the pedicle are densely packed together, while towards the periphery they are more loosely arranged. The muscle fibres of the muscularis mucosæ are



FIG. 78.—Large pedunculated adenoma of colon.

continued upwards into the pedicle immediately subjacent to the mucous membrane, but as they proceed distally the fibres become attenuated and finally disappear. There are numerous blood-vessels, branches from those in the submucosa running upwards in the pedicle to supply the tumour. They are of small size, and their walls consist of lining endothelium surrounded by a single layer of smooth muscle fibres. Compared with the connective tissue between the glands of the tumour, that of the pedicle is much less cellular. Particularly is this so in the centre of the pedicle, only a few spindle-shaped nuclei being present in this situation. Proceeding towards the periphery of the pedicle more cells are seen, the most abundant being the small round lymphocytes, although the other types of cells mentioned when discussing the interglandular connective tissue make their appearance.

The mucous membrane covering the pedicle is essentially the same as that of the intestine with which it is continuous. The glands are the same size, and are lined by clear, mucus-laden columnar cells. Between the glands is the supporting reticulated connective tissue continuous with the periphery of that of the pedicle.

As an adenoma increases in size it undergoes changes which are of considerable importance and significance.

Macroscopically one sees a more or less spherical pedunculated tumour, dark red in colour, and about the size of a hazel nut (*Fig. 78*). The surface is velvety in appearance, distinctly lobulated, and covered with mucus in the recent state. Between the lobulations are clefts which extend inwards for a varying depth. The tissue is very soft and friable, and is easily damaged if not carefully handled.

The pedicle is of varying length, and has lost the rounded outline common to those which measure only a few millimetres. It is flattened—usually from above downwards—and is much broader at its base than at its distal end where it is attached to the tumour. Often it has a ribbon-like appearance produced by longitudinal thickenings of the connective-tissue core. It is smooth and of the same pale-red colour as the mucosa. Usually it arises from the summit of a fold of the mucous membrane of the bowel.



FIG. 79.—Cystic formation in an adenoma. ($\times 36$.)

On section of such a polypus, well-formed vessels are seen proceeding upwards in the pedicle to supply the tumour. The connective-tissue core of the pedicle on reaching the adenoma can be seen dividing up into numerous branches spreading amongst the glandular substance, which is of a red colour and granular in appearance.

Histological examination of the adenoma shows that the glands near the pedicle are lined by regular columnar mucus-laden cells, each with a single large oval nucleus at its base. Little or no cytoplasm is seen. There is a distinct basement membrane composed of a single layer of more or less fused flattened cells of connective-tissue nature united edge to edge.

Proceeding outwards towards the periphery one first comes upon glands which exhibit characteristics similar to those found at the periphery of a small adenoma. Thus the glands are larger in diameter, the nuclei have proliferated, epithelial vegetations are seen, the protoplasm in many cells has become granular, and some cells have lost their polarity. Some of them are seen to have become cystic (*Fig. 79*). Nearer the periphery the glands undergo still further changes. In addition to being larger they become markedly irregular in contour, and are often segmented in the direction of their length. However, amongst these are seen glands which are only enlarged and have no irregularities of outline. The epithelial vegetations are larger,

the nuclei are more numerous and are also enlarged. They are slightly more hyperchromatic than those of the cells lining the glands near the pedicle. Many more of the cells have lost their polarity, and it is no uncommon thing to find two nuclei in one cell, one at the outer and the other at the inner end. Numerous regular mitotic figures are seen placed at the inner ends of the cells.

All these changes indicate a tendency on the part of the cells to become undifferentiated. The cells of the glands near the pedicle are obviously differentiated mucus-producing cells, and as such are fulfilling a definite physiological function. Many of the cells of the glands near the surface have seemingly ceased to perform the function of producing mucus, and are obviously more concerned with proliferation, becoming more and more undifferentiated.

Of the changes in the interglandular tissue with increase in size of an adenoma there is little to be said; the structure is essentially the same, but the gross amount increases *pari passu* with the growth of the glandular tissue.

Pathogenesis and Evolution.—The underlying cause leading to the formation of adenomata still remains uncertain, and no specific work has been done on the problem up to the present time. Two hypotheses come under consideration—first, the inflammatory, and, secondly, that concerned with primary epithelial change. In support of the former is the strong evidence of the development of adenomata in chronic inflammatory conditions, e.g., multiple polyposis, the demonstration of ova of the *Oxyuris vermicularis* in the bases of adenomata, the presence of small round-celled infiltrations and other types of cells indicative of a chronic inflammatory process, and the development of the tumours mostly in those parts of the bowel which are most liable to irritation, i.e., sigmoid and rectum. On the other hand,



FIG. 80.—Early stage in development of a pedunculated adenoma. ($\times 15$.)

Hauser and Bardenheuer believe that a primary change takes place in the epithelium of normal glands, and that the inflammatory reaction seen in the tumour is secondary in nature. The latter author states that the development of the tumours in places in the bowel most liable to irritation is only of significance in their further development. Against the first hypothesis, and supporting the contention of the secondary nature of the inflammatory process, is the fact that the mucous membrane in the neighbourhood of all the adenomata examined showed no sign of any inflammatory reaction, but was perfectly normal in appearance. This fact has also been observed by Quénu and Landel, Hauser and Bardenheuer.

It is comparatively easy to follow the development of an adenoma. At one point in the mucosa there commences a hypertrophy and hyperplasia of the glandular tissue, causing a slight thickening of the mucosa which forms a small fold. Then appears the first suggestion of a pedicle—a slight upward projection of the submucosa (Fig. 80). The larger-sized tumours simply

show an exaggeration of the preceding characters (*see Figs. 77, 78*). The glandular tissue has increased in amount, and rests upon a central stem or pedicle provided by the submucosa covered by mucous membrane continuous with that lining the bowel. The development of the pedicle is usually regarded as being due to two factors—first, the drag upon the tumour occasioned by the constant passage of fæces over it, and, secondly, the peristaltic contractions of the bowel endeavouring to expel what is virtually a foreign body.

The increase in the size of the tumour remains to be considered. Quénu and Landel “testify to a centre of proliferation” situated in the immediate neighbourhood of the pedicle, stating that new glands form in this area and migrate outwards towards the periphery, and that therefore the glands near the pedicle are youngest, while those near the surface are the oldest. The writer, however, holds the opposite opinion. He believes that once the glands have reached the stage of proliferation the tumour increases in size by the formation of new glands, so that the youngest glands are near the periphery. This opinion is held because of the general appearance of these glands—the cells are less differentiated, and therefore younger than those of the glands near the pedicle, while the glands themselves are often seen to be segmenting and thus younger ones are being continually formed.

Adenomatous Polypi and their Relation to Malignancy.—The fact that with the growth of the adenoma the cells tend to become less differentiated has been mentioned. Can this process become so pronounced that the cells may be called malignant, i.e., cells subserving no useful physiological function, but primarily concerned with the embryonic function of proliferation? This is a most important consideration from the standpoint of surgical treatment of adenomatous polypi, and it is a question regarding which histological evidence of its affirmative answer will be submitted.

Seeing that the further from the pedicle the more advanced are the cellular changes, it is in the glands at the periphery of the adenoma that one must search for malignant (carcinomatous) change if it is to be found. The cases of adenomata, particularly the multiple variety, associated with carcinoma which have been recorded in the literature are so numerous that it has become the general opinion among pathologists and surgeons that the adenomata are definitely capable of undergoing malignant change. This conclusion, however, appears to rest mainly on clinical rather than histological grounds, the association of the two conditions being taken as the complete proof. Bardenheuer, and, later, Quénu and Landel, were the first authors to bring forward histological evidence of the malignant transformation of adenomatous cells. They showed that scattered throughout the larger adenomata were areas definitely carcinomatous in character. In this connection Lockhart-Mummery says: “The most important factor in connection with simple adenomata, whether of the single or multiple variety, is that they show a marked tendency sooner or later to become malignant, i.e., for the cells to penetrate the basement membrane and invade the surrounding structures. I am of opinion that all adenomata of the rectum eventually take on malignant change, and in the great majority of cases in which large adenomata have been removed, malignant change has been found to have already occurred in some part or other of the tumour. So marked is this tendency

for simple adenomata to become malignant, that personally I look upon adenomata as merely a stage in the development of malignant disease, and regard simple adenomata of the rectum as a definitely precancerous condition. It follows from this that on no account should a single adenoma of the rectum be allowed to remain, even if it is causing no troublesome symptoms; it should be freely removed as soon as possible."

Tuttle believes that the chances are that in about three out of four cases of multiple adenomata malignancy occurs in some of the growths sooner or later.

Of the cases examined in this series, in none of the adenomata of the multiple variety was carcinomatous change found—possibly because they had not attained a sufficient size in their development. The change was met with in three adenomata; all were single, all were about 4 cm. in diameter, and all were situated in the sigmoid colon; two of them were attached to the wall of the bowel by large, long pedicles (*Fig. S1*), while the third was sessile.



FIG. S1.—Large pedunculated adenoma of sigmoid colon.

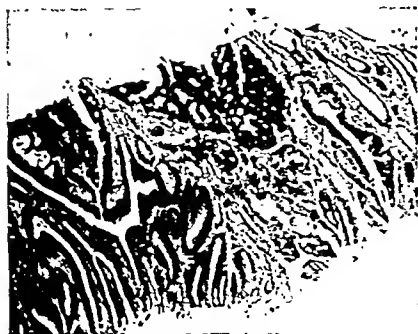


FIG. S2.—Carcinomatous area at periphery of adenoma shown in *Fig. S1*. ($\times 13$.)

Fig. S2 is a photomicrograph of a section taken from the periphery of one of the large pedunculated adenomata mentioned above. In it are seen glands which as regards irregularity of size and shape, granular appearance of the cells, etc., conform to the description given of many of the glands which are to be seen towards the periphery of any fairly large adenoma. In these, though the cells have been undergoing a marked degree of proliferation, there is yet nothing to indicate a malignant change. There is, however, one area which obviously possesses characteristics different from the remainder of the section. Acini are seen in which are numerous cellular ingrowths; these

unite with others and so form epithelial partitions dividing up the acini irregularly. The cells are devoid of differentiation, and it seems as though the acini contained irregular masses of multinucleated protoplasm. The nuclei have proliferated and are arranged throughout the granular protoplasm in a most disorderly manner. They are irregular in shape and staining reactions, and several irregular mitotic figures are seen. Regular mitosis is seen occasionally in normal glands of mucous membrane. It is characteristic of epithelium which, for some reason—c.g., in benign tumour formation or in response to inflammation—is undergoing proliferation. Irregular mitosis, on the other hand, means that proliferation is so rapid that it is only seen in cells which are concerned with the embryological function of propagation; these of course being considered malignant. The nuclei are also distinctly larger than those found in the other acini; they stain more darkly, and are richer in chromatin bodies. (*Figs. 83, 84.*)



FIG. 83.—High magnification of edge of carcinomatous area, showing contrast between its cells and those of the adjacent benign alveolus. Absence of basement membrane and invasion of the connective tissue by malignant cells. ($\times 150$.)

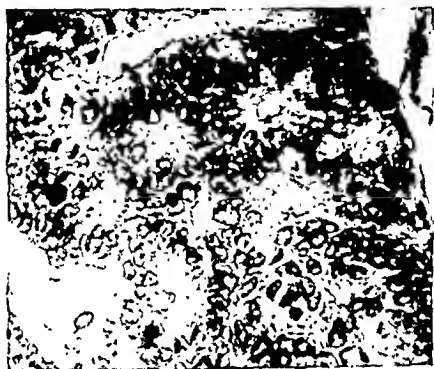


FIG. 84.—Higher magnification of carcinomatous area, showing irregularity in size and undifferentiated nature of the cells and mitotic figures. ($\times 240$.)

At one part the basement membrane has completely disappeared and the cells are invading the surrounding connective tissue. Opinions differ as to the significance of the disappearance of the basement membrane. Lockhart-Mummery, Cornil, Ranvier, and David consider it to be pathognomonic of malignancy; Quénu and Landel state that they have only found the basement membrane in benign adenomata in a very inconstant manner, so that they do not attach much importance to its presence—or absence; Broders also holds the latter view.

Several sections taken from the periphery of this adenoma showed in nearly every case one or more small areas of carcinomatous change, while the glands and cells of those cut near the pedicle were all essentially benign. In the second pedunculated adenoma, similar in size to the first, malignant areas differing but slightly from that described above were discovered in sections taken from the periphery.

The third adenoma in this series in which malignancy was discovered was sessile, but similar in size to the others. Macroscopically one would have described it as a carcinoma, and it was not until it was examined microscopically that it was found to be an adenoma which had undergone considerable malignant change. In the section (*Fig. 85*) are seen many acini lined by well differentiated mucus-producing cells. Side by side with these, at the periphery of the tumour, are acini which may be safely designated malignant—irregular in outline, with numerous epithelial vegetations projecting into their lumina, great multiplication of nuclei which are larger than those of the mucus-secreting cells and stain irregularly and more deeply. It is interesting that in the same acinus as those cells which are apparently malignant are others quite well differentiated and apparently benign.

In the base of the tumour many irregular acini were seen invading the muscular coat of the bowel. In some of these, the cells, although showing signs of proliferation, were yet well differentiated and mucus-producing, and in fact could only be called malignant because of the position they occupied, having obviously infiltrated the tissue to get there. Thus it would seem that malignant cells which can infiltrate and destroy tissue, though usually having been bereft of their normal physiological function, yet in some instances may retain it in greater or less degree, thus adding to the difficulty in some cases of deciding whether certain cells are, or are not, malignant. The basement membrane is present in some of the glands and not in it is sometimes seen in one part of a gland others, so that it is not possible to lay great stress upon its presence or absence. Again, and is absent in another. When it is absent, the cells can be seen definitely invading the surrounding connective tissue. Considering the mixture of innocent and malignant acini seen, I think one can safely say that the tumour was primarily an adenoma which had undergone malignant change.

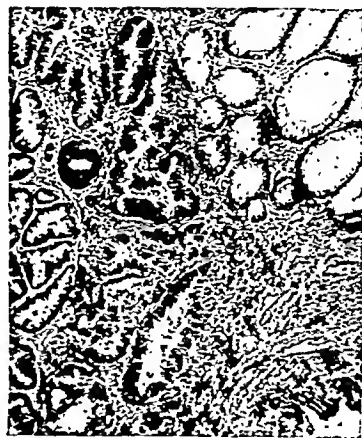


FIG. 85.—Benign and malignant glands in large sessile adenoma. ($\times 36$.)

The Association of Adenomata with Carcinomata.—In the 36 cases of this series in which adenomatous polypi were found carcinomata occurred in 13. None of the adenomata in these 13 cases showed carcinomatous change. However, it must be stated that none of them had grown to anything like the large size of those mentioned in which carcinomatous change was found.

Considering the large number of carcinomata of the large bowel encountered without adenomatous polypi being present, the association of the two conditions in the same intestine is not very frequent, and it would seem that although carcinomata occur which are undoubtedly the outcome of malignant change taking place in adenomata, yet the majority arise *per se*. An interesting specimen bearing on this subject was found in this series. In the

wall of the sigmoid colon there was a flat hard plaque 2.5 cm. in diameter, more or less circular in outline and raised about 2 mm. above the surface of the mucosa. *Fig. 86* illustrates the appearance of a section taken from the edge of the tumour. It is obviously a carcinoma. The abrupt change between the normal mucous membrane and the carcinomatous acini is well shown. The acini have grown downwards and invaded the muscular coat of the bowel. One striking thing about the section is that there is no suggestion of simple adenomatous formation, the acini without exception being carcinomatous in character. This tumour the writer believes to be a small primary carcinoma.



FIG. 86.—Primary carcinoma of intestine. ($\times 15$.)

The following tables show the relation between number and sex and the age incidence of the cases of polypi of the large intestine in this series.

Table VII.—NUMBER AND SEX INCIDENCE.

| 44 CASES. | | | |
|--------------|--------|----------------|--------|
| Single 24 | | Multiple 20 | |
| Male | Female | Male | Female |
| 17 | 7 | 14 | 6 |

Table VIII.—AGE AND SEX INCIDENCE.

| AGE Years | MALE | | FEMALE | |
|--------------|--------|----------|--------|----------|
| | Single | Multiple | Single | Multiple |
| 20-29 | 0 | 2 | 0 | 0 |
| 30-39 | 1 | 0 | 2 | 3 |
| 40-49 | 3 | 0 | 2 | 1 |
| 50-59 | 5 | 2 | 2 | 0 |
| 60-69 | 6 | 6 | 1 | 1 |
| 70-79 | 2 | 4 | 0 | 0 |
| 80-89 | 0 | 0 | 0 | 1 |

In this series, therefore, single polypi were met with more frequently than those which are multiple. From *Table VIII* it is apparent that polypi may be found in the large intestine at almost any age. They were in greatest number between the ages of 60 and 69.

CONCLUSIONS.

1. Polypi occurred with much greater frequency in the large than in the small intestine, the proportion being 4 to 1 approximately.

2. In the small intestine polypi due to glandular hyperplasia were the commonest type.

3. In the small intestine the ileum, and in the large intestine the sigmoid, were the most frequent sites of occurrence of polypi.

4. In both small and large intestines polypi occurred more frequently in males than females.

5. In the large intestine the adenoma was the type of polypus most frequently met with.

6. Adenomatous polypi were found capable of undergoing malignant change.

7. Malignant change was demonstrated to commence at the periphery of the tumour.

8. This change was not observed in any adenoma which was smaller in size than a walnut.

APPENDIX.

With a view to gaining an idea of the appearance of a polypus when magnified a large number of times, reconstruction in wax of one of them (a pedunculated adenoma) was undertaken. Below is a description of the apparatus and technique used.

The wax was a mixture of three constituents, viz., beeswax, paraffin wax, and resin, in the proportion of 3 : 2 : 1. The aim is to produce a wax which will not split when cut by a knife, and for this reason beeswax and paraffin wax alone or together are unsatisfactory. The mixture is heated until it melts. Plates of this material of the desired thickness are made and allowed to harden by cooling.

The apparatus used consists essentially of two parts, an iron roller and a metal plate, which must be horizontal. The roller is a cylinder 18 in. long and $3\frac{1}{2}$ in. diameter, having at each end a cylindrical projection of $1\frac{1}{2}$ in. diameter used as a handle. The roller rests on a stand placed just behind the horizontal plate, over which it can be easily pulled forwards, and under it is a multiflame Bunsen burner. The horizontal plate measures 16 in. by 14 in., and is fixed between two vertical metal sides about $\frac{1}{4}$ in. in thickness. Each of these has two vernier gauges, one near either end, and by means of these the plates are raised above the level of the horizontal plate, the exact amount corresponding to the required thickness of the wax plate.

The roller and horizontal plate are now heated, the former by its special burner, the latter by pouring on alcohol and setting it alight. After the alcohol has burned, the residual water is wiped off and the plate smeared well with xylol, toluol, or oil of turpentine. A sheet of waxed paper of width equal to that of the plate is then placed on the latter and smoothed out with xylol. The melted wax is next poured on to the plate, the roller brought forward from its stand and moved forwards and backwards on the two vertical plates, flattening out the wax in a uniform manner, and then replaced on its stand. As soon as the wax has solidified, it is cut with a knife along its whole length just internal to the vertical plates. The waxed paper is raised in front along its whole breadth by means of a knife: the raised part is then seized, the sheet of wax being lifted off the plate (this being done with ease owing to the previous use of xylol) and set aside to harden. When it has done so, the waxed paper is stripped off it, this operation being performed with little difficulty, owing to the smearing of the waxed paper with xylol.

To obtain the optimum temperatures of the melted wax, the roller, and the horizontal plate is a matter of experiment. If they are too low, the wax will harden before one has time to use the roller; if too high, an enormous amount of time will be wasted waiting for the wax to solidify before taking it off the metal plate.

The polypus was taken, fixed and embedded in the usual manner, and serial sections were cut and stained. Each section was 10 micra in thickness and the magnification 30. Then in order to utilize every section a wax plate 0.3 mm., i.e., 30×0.01 mm., in thickness would be necessary. However, it was found that the smallest satisfactory thickness of wax with which to work was 1.5 mm., and so only one in every five of the serial sections made could be used, as otherwise the model would be five times too long in proportion to its width.

A microscope was fixed in a horizontal position, and the ordinary eyepiece replaced by one with a right-angled prism so that the horizontal beams of light were reflected downwards in a vertical direction on to a sheet of paper. A slide was inserted, and, after the image of the polypus had been focused on the paper, its outline was drawn. The paper was laid on one of the wax plates, and the outline



FIG. 87.—Model of pedunculated adenoma.



FIG. 88.—Model showing same adenoma as in Fig. 87 on section.

of the polypus traced with enough pressure to make it appear on the plate. After the removal of the paper the wax was cut with a tenotome along the outline of the polypus.

To ensure accuracy in the assembling of the wax plates which had been cut out, three points were taken as far apart as possible on the first outline drawn. Before the second sheet was traced on the wax it was held up to the light under the first sheet, the two outlines being easily seen. The latter was correctly superimposed on the former, and the three points were traced through. This process was carried on throughout. After each outline had been traced on the wax plate, the three points were stamped through, and afterwards holes were made through the wax by a sharp peneil at these points. A thread was passed through each corresponding hole throughout the whole thickness of the model, and thus correct superimposition of each wax plate on the preceding one was ensured.

After the plates were assembled they were pressed together and the remaining lengths of thread cut. The whole surface was then treated with an electric cautery,

making the plates adhere to one another and smoothing out the irregularities of the model.

The completed model was then painted in as natural colours as possible (*Fig. 87*). The depressions represent the mouths of the glands which open on the surface, and those of the tumour are seen to be larger than those of the mucous membrane covering the pedicle and lining the bowel. *Fig. 88* is a photograph of a second model made to show the same polypus on section.

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SOME GENERAL DISEASES OF THE SKELETON.

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THE group of affections which it is proposed to consider to-day has a peculiar fascination, since little or nothing is known as to the causation of many of them, and the diagnosis and treatment of the individual cases are made an occasion of most interesting consultations between the physician and the surgeon. The light-heartedness inspired at the start by the interest of the subject chosen for this address soon vanished when an intensive study was commenced of the pile of radiograms and case records that had been collected with the help of many generous colleagues. The further the study proceeded, the more obvious became the size and complexity of one's task. At present the investigation of the material available has done little more than reveal some of the difficulties with which the subject is surrounded.

Many of the doubtful questions will not be solved for years to come; not indeed until much work has been done by the biochemist, as well as the pathologist and clinician. All we can manage to do to-day is to refer to a few of the problems.

We are gradually learning more about the normal process of ossification and the growth of the bones. Calcium and phosphorus in proper amounts are, of course, essential to this process. R. Robison¹ has worked at the chemistry of the subject, and has shown that an ester—hexose monophosphate ester—plays an all-important part in the conveyance by the blood of the calcium, with which it forms soluble salts. This combination of the ester and calcium is hydrolysed by a ferment present in ossifying cartilage, calcium phosphate with some calcium carbonate being deposited around the osteoblasts. Now this ferment is only found, except in minute quantities, in two other places in the body besides ossifying cartilage, viz., the intestines and the kidneys, where, it has been suggested, it plays a part in the absorption and excretion, respectively, of calcium. It is noteworthy that the ferment is absent from muscles. This piece of work opens up great possibilities for research and sets one thinking. Is it possible that the presence of this ferment in abnormal situations, or in abnormal quantities in normal situations, is responsible for some of the affections we are now considering? What bearing has this research work on delayed union of fractures about which we are so anxious for further information? Has it anything to do with the question of non-union in an apparently healthy person where no anatomical explanation can be found? Is its action inhibited or destroyed by synovial fluid? To go further afield, is the presence of the ferment in abnormal situations responsible for the calcification in joint capsules, muscles, and tendons that sometimes follows trauma, and for the deposit of lime salts in the walls

of blood-vessels and other tissue? Further reference will be made to this ferment later.

For the normal development of bone three things are necessary: (1) A proper cartilaginous or membranous scaffold or foundation for the bone: (2) The deposit of the necessary inorganic salts: and (3) A sufficient number of normal bone-forming cells. If the scaffold is not set up, no bone develops, and if extra scaffolding is erected, we get supernumerary bones or digits formed, or even complete limbs. Abnormality in the structure of the scaffold or in its adaptability to the changes involved in the formation of bone might be expected to play a part in the production of some of the gross errors of skeletal development that we meet with; such abnormality is regarded by Jansen² as the fundamental cause of some of the congenital conditions we are considering. Deficient deposit of lime salts in a developing bone may arise either from a scarcity of these salts in the circulating blood, or from some inability on the part of the individual to eliminate them. Much research work has been done on calcium metabolism, but much remains to be done. We know that in rickets the intake and excretion of calcium are increased and the blood calcium is usually normal in amount, though the phosphorus in the blood is often diminished. In osteomalacia of all kinds the excretion of calcium is said to be much increased without any increase in the intake, so that the amount in the circulating blood is diminished. Cod-liver oil, by the way, has no effect on the excretion of calcium. In osteogenesis imperfecta neither the intake nor the excretion is increased, while the blood calcium may be either above or below the normal 9 to 11 mgrm. per 100 c.c. In two ante-natal cases of this affection at the Hospital for Sick Children the figures for the blood calcium were 12.3 and 5.45 respectively. In renal rickets the blood calcium is said to be diminished. Interesting though these findings are, they do not help us much, at present at any rate, with the etiology of these diseases. With regard to the third factor, the osteoblasts, again we find a great field for research work. Lawford Knaggs³ in cases of osteogenesis imperfecta found a marked deficiency in these bone-forming cells, the dearth of which he regards as the essential cause of all forms of this affection. Fat-soluble A, which plays such an important, though at present obscure, part in the normal growth and calcification of bones, is not as simple a vitamin as we used to think. Having changed into twins, it has now become triplets, the names of the brothers being A, D, and E.

The consideration of the large number of recognized general bone affections demands a classification of some kind, and I venture to suggest the following:—

Table I.—GENERAL AFFECTIONS OF THE SKELETON.

Congenital Developmental Errors—

| | |
|-------------------------|---------------------------------|
| Osteogenesis imperfecta | Cranioceleido dysostosis |
| Diaphysal aplasia | Ateliosis |
| Dyschondroplasia | Myositis ossificans idiopathica |
| Achondroplasia | |

Errors of Metabolism—

| | |
|----------------|------------------------------------|
| Scurvy | Dwarfism associated with: |
| Rickets | 1. Cœliac disease |
| Renal dwarfism | 2. Pancreatic disorder |
| | 3. Hypertrophic cirrhosis of liver |

Endocrine Errors—

Gigantism
Aeromegaly
Mollities ossium

Osteomalacia
Dwarfism and infantilism of various
types (*see Table II*)

Affections of Unknown Origin—

Fibrocystic disease
Leontiasis

Osteitis deformans
Arachnodaetyly

Multiple Neoplasms.

Though no doubt this classification is open to criticism on some points, and its revision will be necessary in the light of further research, it is hoped that it will serve as a foundation. We may now proceed to discuss a few points of interest in connection with some of the affections cited in this table.

CONGENITAL DEVELOPMENTAL ERRORS.

Osteogenesis Imperfecta.—Thomson⁴ divides these cases into two groups—namely, the intra-uterine disease which is frequently fatal, and that which



FIG. S9.—Osteogenesis imperfecta, Type 1, with short limbs. Age 2 days.
(Under Dr. G. F. Still.)

develops later and is associated with blue sclerotics. There seems to be no sharp distinction between these two groups. A study of the histories and



FIG. 90.—Osteogenesis imperfecta, Type 1, age 10 weeks. (Under Dr. Poynton.)

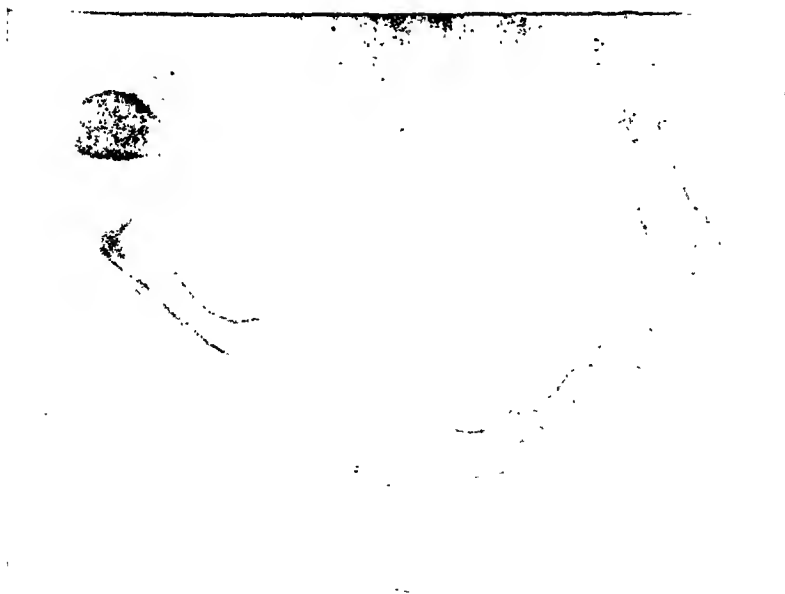


FIG. 91.—Same case as *Fig. 90*, showing legs.

radiograms of some 18 cases has shown that it is possible to recognize four clinical types, but it is not suggested for an instant that these represent four different diseases. As a matter of fact it seems more than likely that the first three at any rate are the result of one and the same disease. These types are: (1) The young infants born with multiple fractures—the so-called foetal type—and showing a marked stunting of the limbs as compared with the trunk (*Fig. 89*). Radiograms show the femora and humeri, and less frequently the tibiae, to be short and strikingly thick in proportion to their length. These bones show one or more fractures with abundant callus, but this hardly seems



FIG. 92.—Osteogenesis imperfecta, Type 2, showing simple fragility of bones.
Girl, age 2½ years. (Under Mr. Tyrrell Gray.)

to account for the obvious enlargement of the whole of their shafts (*Figs. 90, 91*). (2) The type with slender bones, poorly calcified, and showing an abnormally thin cortex (*Fig. 92*). (3) The type with honeycombing of the bones, which bend as well as break (*Figs. 93, 94, 95*). (4) The type with bones which are denser than normal and have their medullary canals diminished or obliterated—the so-called 'marble bones', first described by Albers-Schönberg in 1904.⁵

Cases of the first type rarely survive for long. The second type includes

the great majority of the cases seen in childhood, and occasionally in adolescent and adult life. Some are born with a fracture or two; some develop the tendency to fractures after birth; in some the bone fragility seems to disappear after a time. Some of these cases go from bad to worse, develop marked deformities, become bedridden, and sooner or later succumb to intercurrent disease. The severe cases, with the characteristic broad skull which bulges laterally above the ears so that the latter face downwards and outwards, belong either to this group or to the third group with honeycombed bones. I am not prepared to say at present whether the third type is or is not a late development of the second. Many, but not all, of these severe cases have blue sclerotics, a feature which is not, by the way, confined to those with a post-natal onset. There seems to be no definite line to be drawn either between the first two groups or between the second and third. Softening and bending are seen in some cases and not in others, in addition to the fractures and the deformities resulting therefrom. As to the cause we are still in the dark. Lack of vitamin A during pregnancy, as suggested by Thursfield,⁶ cannot, I think, be the cause, for, if this theory were correct, the disease should be more amenable to treatment. Light treatment does not affect these cases materially. Knaggs⁷ attributes all the cases to the same cause, namely, a failure of the evolution of the highly specialized osteoblast, which he found markedly deficient in numbers, but he can suggest no reason for this failure. It would be of great interest to know whether there is any lack of Robison's ferment in the ossifying cartilage in these cases.

'Marble bones' are in quite a different category, the only resemblance they have to the three preceding groups being the fragility of the bones (*Figs. 96, 97*). The feature of the group is a great excess of lime salts in the bones. It appears to be a rare disease, which may be met with in both sexes and at all ages—the ages of the recorded cases ranging from 3 weeks to 43 years. In addition to the bone changes, calcareous deposits are seen in the dura and in the ligaments. The diagnosis is revealed by the X rays, which show greatly increased density of all the bones, with opaque patches of calcareous

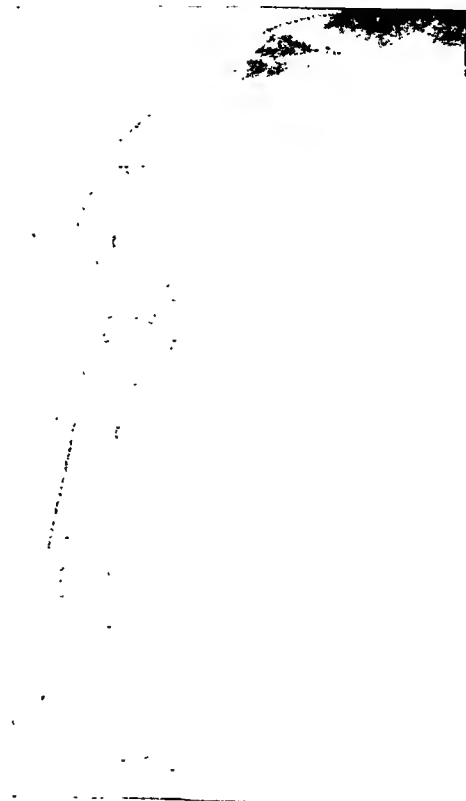


FIG. 93.—Osteogenesis imperfecta, Type 3, with honeycombed bones. Girl, age 5½ years. Upper limb.

material, thickening of the cortex of the long bones, and reduction of the medullary canal. I have only one case which seems to be of this type, though it does not show the more striking radiographic appearances of the well-marked disease. A girl of 12 sustained her first fracture of the tibia when 5 years of age, and in the succeeding five years one or other tibia was fractured seven times. All her bones are abnormally dense and structureless, the cortex of the shafts of the long bones is unduly thick, and the medullary

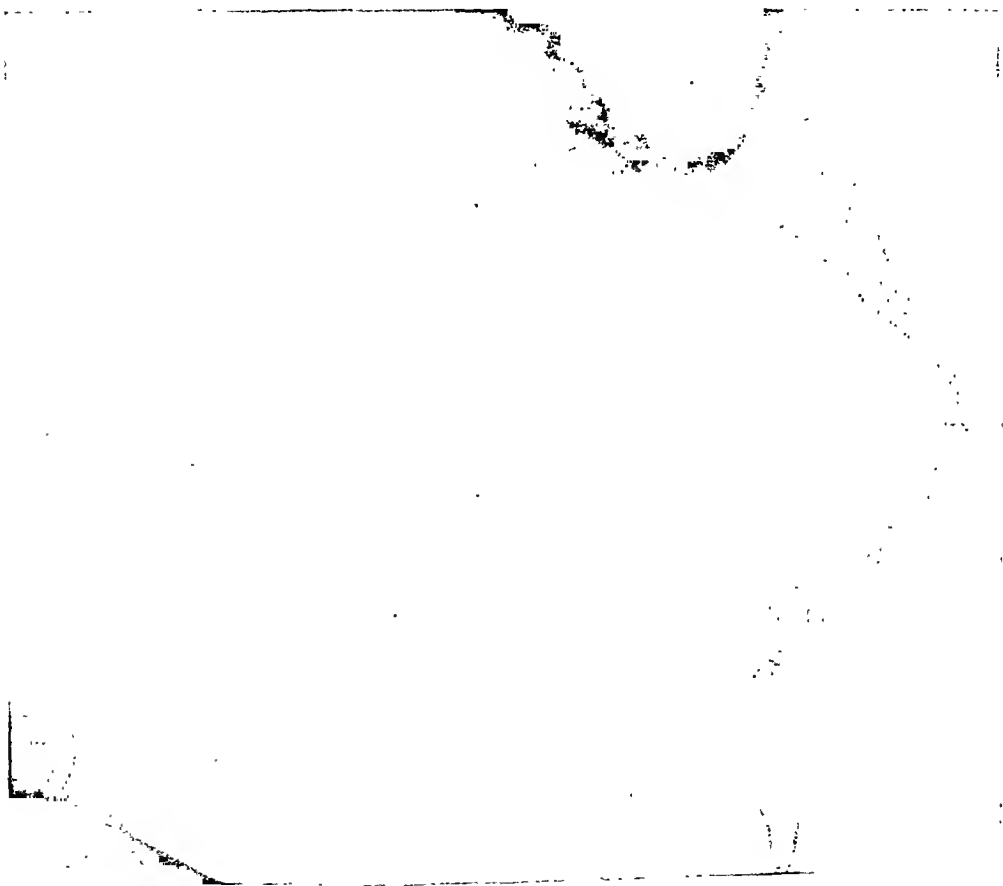


FIG. 94.—Same case as *Fig. 93*, showing legs.

canals are reduced in size. The tibiae gave way at the same spots on each occasion. Union took place slowly and was obviously imperfect. The head, though not typical, was broad, and the chin was pointed. The sclerotics were definitely blue. Is it possible that an unusual supply of the ferment discovered by Robison is responsible for this excessive calcification? This would mean the abnormal presence of this ferment in the bone already formed, as well as an excess in the ossifying cartilage, for the abnormal density of the bones persists in some cases even in adult life. Deficiency in the number

or nature of the osteoclasts present is another possible explanation, I suppose.

Dyschondroplasia.—This name is usually applied to a condition described by Ollier^s in 1898 and characterized by dwarfing of the affected limbs, coupled with irregular ossification at the ends of the diaphyses of the long bones. It is commonly unilateral, but by no means always so. The ends of the affected



FIG. 95.—Same case as Fig. 93, showing pelvis and femora.

diaphyses are enlarged, and show a number of translucent areas which are filled with cartilage. The hands and feet are often affected, but the carpus and tarsus are normal. The disease is much more common in males, and is often hereditary. Although the contrary is said to be the case, I believe the affection is essentially congenital, though there may be comparatively little sign of it at birth. By the courtesy of Dr. Gordon Pugh I am able to give

radiograms of a case under his care (*Figs. 98, 99*). In this case, a boy of 12, the disease is practically confined to one side of the body. I would call particular attention to the combination of clear areas with opaque spots at the ends of the diaphyses in this case. The epiphyses appear to be fairly normal, and in this the case agrees with the usual description of the disease. In another typical case, however, we see, at the age of 3 years, mottling and honeycombing of the epiphyses associated with the usual changes at the ends



FIG. 96.—Osteogenesis imperfecta, Type 4, 'marble bones'.
Girl, age 12 years. Tibiae.

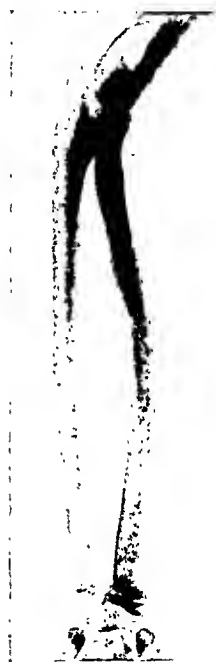


FIG. 97.—Same case as *Fig. 96*,
showing forearm.

of the diaphyses (*Fig. 100*). In 1924 Voorhoeve,⁹ of Amsterdam, published three cases, members of one family, with curious striation of the ilia and the diaphyses of the long bones somewhat similar to that seen in a case published by myself last year.¹⁰ He analyses the literature on the subject most carefully, and points out how frequently striation, clear spots, and spots of increased density can be made out in the radiograms of a single case, though one or other of these features may predominate. He argues that all these

changes are due to errors in the ossification of cartilage, and that therefore they should all be placed in one class, the dyschondroplasias. He even includes the condition called by Albers-Schönberg 'osteopathia condensans disseminata'.¹¹ In this the dense spots, which may be few or many, are more regular in outline than those seen in a typical Ollier's disease, and are usually oval, with the long diameter parallel with the long axis of the bone. These spots have been seen in the epiphyses as well as the metaphyses, and, indeed,



FIG. 98.—Dyschondroplasia (Ollier's disease). Boy, age 12. Left knee showing clear areas, dark spots, and striation. (Dr. Pugh's case.)



FIG. 99.—Same case as Fig. 98. Left forearm.

in every bone except the ribs and the skull. These changes are always found by accident and are not associated with any symptoms. Though sceptical at first, I must confess that Voorhoeve seems to me to make out a fairly good case for his views. Even if we follow him and group together all these errors in the transformation of cartilage into bone under the title of dyschondroplasia, we must recognize several distinct types.

In this connection I should like to mention two cases showing mottling

confined to the short bones and to the epiphyses of the long bones. The first was an infant of one month with a congenital shortness of one leg (*Fig. 101*). The epiphyses of the long bones of the leg, and the tarsal bones, are represented by a number of discrete dense spots giving a curious stippled appearance. Unfortunately the case was lost sight of after its first visit to the hospital, but inquiries elicited the fact that it died when nine months old. The other case was under the care of Dr. Eric Pritchard at the Infants' Hospital, who kindly allows me to refer to it (*Figs. 102, 103*). The child, age 2 years, was



FIG. 100.—Dyschondroplasia (Ollier's disease). Boy, age 3. Note changes in epiphyses as well as shafts.



FIG. 101.—Congenital short leg. Child 1 month old, showing stippled epiphyses and tarsal bones.

decidedly small for its age, and showed some of the stigmata of rickets. The limbs were not disproportionately short, but there was contracture of both elbows and knees. The X rays showed the epiphyses to be stippled, much as in the preceding case, and the shafts of the long bones to be stouter than normal, with trumpeted extremities. In this case the changes were bilateral, while in the other apparently unilateral. In both the ossification of some epiphyses and of some of the small bones had commenced much earlier than



FIG. 102.—Elbow of child, age 2 years, showing stippled epiphyses. ? Dyschondroplasia.
(Under Dr. Eric Pritchard.)

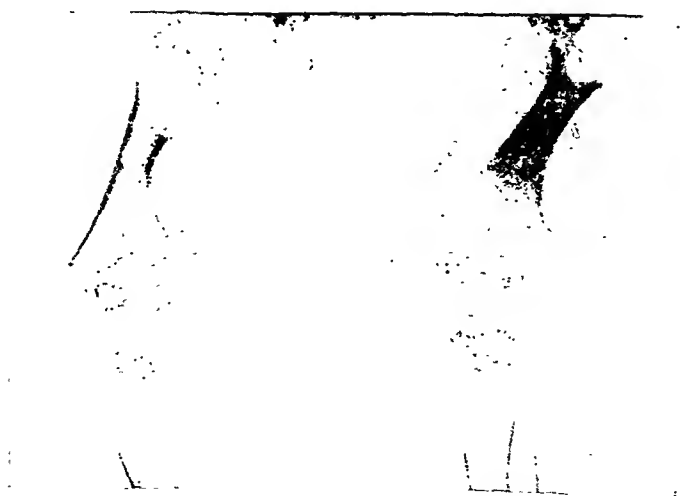


FIG. 103.—Legs of same case as Fig. 102.

usual. It is difficult to fit these into the dysechondroplasia group, and it would seem necessary at present to regard them as examples of an entirely separate and, perhaps, a new affection.

Before leaving this group I must refer to the work of Bentzon,¹² who regards Ollier's disease as the reaction of the bones against certain disorders of the innervation of their blood-vessels. He called attention to the fact that the clear areas in the diaphyses were arranged in fan shape, radiating



FIG. 104.—Boy, age 4½ years, showing enlarged epiphyses and other deformities of unknown origin. (Under Dr. Hugh Thursfield.)



FIG. 105.—Upper limb of case, shown in Fig. 104.

from the point of entry of the nutrient vessel towards the epiphyscal line, i.e., along the lines followed by the vessels. In a series of 23 experiments in which he injected alcohol round the nutrient artery of the tibia in rabbits, he produced changes like those in Ollier's disease in 2. Shortening occurred, and clear areas appeared, and these he proved to be free from vessels and to be filled with cartilage. In another series of 30 experiments he destroyed the sympathetic with alcohol, but only in one did he obtain any result, a phalanx showing changes a month later.

Achondroplasia and Craniocleido Dysostosis.—One of the chief points of interest in connection with these conditions is the most ingenious and admittedly attractive theory of Murk Jansen.¹³ This theory presupposes the existence of abnormal amniotic pressure during a short period, a mere matter of days apparently, in early foetal life. This temporary pressure is said to produce permanent injurious effects on the portions of the skeleton which happen to be undergoing particularly active changes during the period of its operation. There seem to me great difficulties in the way of accepting this theory. We have no proof at present of the existence of this excessive amniotic pressure. Why should a pressure sufficient to produce such harmful



FIG. 106.—Feet of same case as Fig. 104, showing abnormalities of big toes.

effects exist only for so brief a period? Why should a temporary pressure produce such lasting effects?—for the error of development, whatever its cause, continues throughout the whole of the growing period of the subject affected. If a chance increase of pressure be the cause of achondroplasia, how is it that these cases are so singularly true to type? The epiphyses in achondroplasias are at least normal in size and well formed. The appearance of their centres of ossification may be either unduly advanced or unduly delayed. Why should the ossification at the epiphyseal line be so markedly affected while in other respects the epiphysis is well formed and apparently performing its functions?

Let us look at some radiograms of these conditions. In *achondroplasia*,

if one disregards the shortness of the diaphyses and the trumpeting of their ends, the most marked and really characteristic feature seems to me to be the position of the ossific nucleus in the epiphysis. This centre of ossification always appears close up to the end of the shaft of the bone, instead of in the usual situation, which is much nearer the centre of the epiphysis. The end of the shaft is usually funnel-shaped, and the epiphyseal centre is fitted into the hollow thus formed. It is rather doubtful whether, clinically, the epiphyses are really larger than the normal, or only apparently so. Comparing the knees of a case with those of a normal boy of the same age, it is obvious that the epiphyses of the achondroplastic are at least as large as the normal. The diminution in size of the big toe, emphasized by Jansen, appears to be due to shortness of the first metatarsal, a point



FIG. 107.—Craniocleido dysostosis. Boy, age 3½ years. Note absence of ossification of pubis. (Under Mr. Barrington-Ward.)

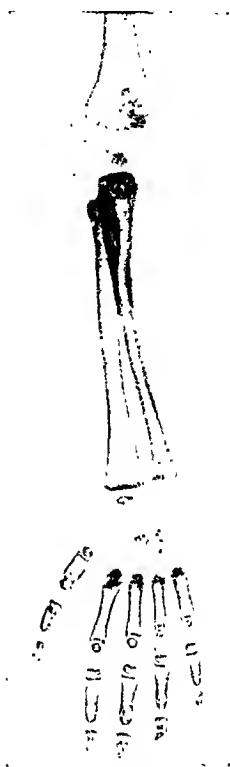


FIG. 108.—Forearm of same case as Fig. 107.

which may be contrasted with the diminutive first phalanx seen in myositis ossificans. Thomson¹⁴ refers to two types with short limbs that are not achondroplasias. The first is congenital, and has a normal head, very convoluted auricles, and typical hands, the fingers being contracted and bent towards, not away from, the median line of the limb. The second type, described by Herringham and Drysdale,¹⁵ is an hereditary condition acquired after birth. The hands become stunted, and the fingers thick, fleshy, and conical, but quite parallel. The phalanges are thickened, and the ossification of these and the carpus is much delayed. A case seen with Dr. Thursfield¹⁶ is worthy of mention, since at the first glance it was not unlike an achondroplasia (Figs. 104–106). The striking peculiarities are: (1) Enormous enlargement of the epiphyses; (2) Enlargement of the big toes and the first

metatarsals. with limited motion in the metatarsophalangeal joint and ankylosis of the terminal joint; (3) Stiffness of the fingers; (4) Kyphosis and scoliosis; and (5) Coxa vara.

In *craniocleido dysostosis*. apart from the well-known abnormalities, we find others which have not, I think. attracted particular attention, and which seem to be very difficult to explain on Jansen's theory. In the case, age $3\frac{1}{2}$, which my colleague Mr. Barrington-Ward showed to this association two years ago. he called attention, among other points, to the complete absence of ossification in the pubis and in the carpal bones, and to the presence of epiphyses at both ends of several metacarpals and phalanges (*Figs. 107, 108*). In a case, age 6, which I showed before the association,

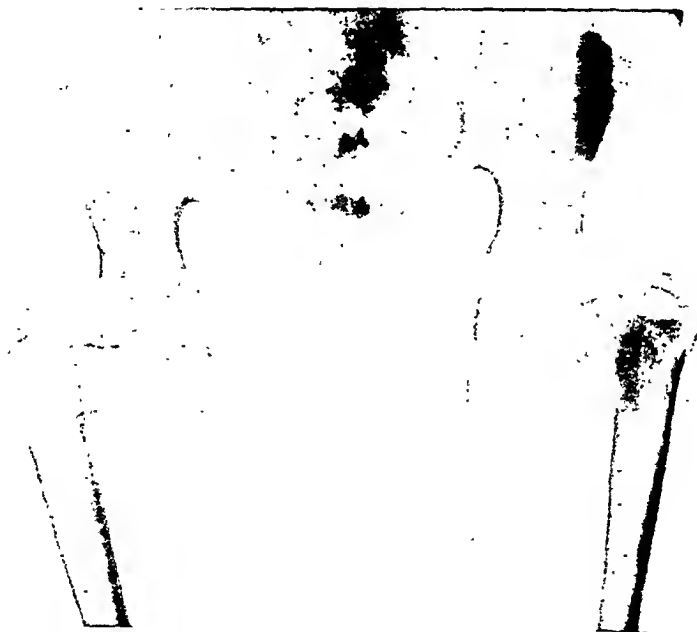


FIG. 109.—Craniocleido dysostosis. Girl, age 6. Note absence of ossification of pubis, and coxa vara of infantile type.

these abnormalities in the pubis and metacarpals are also seen (*Figs. 109, 110*), while in addition there is bilateral coxa vara of the cervical or infantile type. Mr. S. T. Irwin, who drew my attention to the true nature of this second case, kindly sent me radiograms of a case of his own where the pubis was unossified and there was bilateral coxa vara. In both these cases with coxa vara the heads of the femora encroach on the necks above in a quite abnormal manner, a point I have noted in many cases of infantile coxa vara unaccompanied by signs of dysostosis elsewhere. I find it very difficult to explain these abnormalities by any pressure theory. Entire absence of the pubis one could understand, but the pubis is not absent: it is present, but unossified. The condition of this bone in adolescent and adult cases of this affection I am not

at present able to state. It seems to me that the suggestion that achondroplasia is a reversion to an ancient pigmy type is probably correct, and dysostosis is a developmental error resulting from an influence of a similar kind.



FIG. 110.—Hand of same case as Fig. 109, showing abnormal ossification.

Ateleiosis, the cause of which is unknown, is the name given by Gilford¹⁷ to the type of retarded growth which provides the majority of the professional dwarfs.

Myositis Ossificans Idiopathica.—

This is unquestionably a congenital affection. In a considerable number of cases of this rare condition, partial or complete suppression of the proximal phalanges of the thumb and big toe has been reported, while other errors of ossification have been met with. These are unquestionably congenital. Though no case, I believe, has ever been recognized at birth, Sir Archibald Garrod met with it at 5 months,¹⁸ and it usually becomes obvious in childhood. While in common with the traumatic variety the masses of bone later become attached to the normal skeleton, it displays this marked difference from the traumatic affection, that a mass of bone once formed never disappears. It would

seem therefore that this affection can be regarded as a skeletal abnormality, the gradual development of which is determined before birth.

ERRORS OF METABOLISM.

Scurvy.—Dr. Bertram Shires has pointed out to me, as a characteristic feature of radiograms in infantile scurvy, the presence of a dark line at the end of the diaphysis with a light band behind it, in addition to the subperiosteal shadows which may or may not be present. That scurvy is sometimes met with, even in these enlightened days, in older patients, was proved by the case, age 18, which Dr. Cassidy¹⁹ showed before the Royal Society of Medicine three years ago. The most noticeable features in the radiograms were triangular patches of great density occupying a central position towards the ends of the diaphyses of the long bones. In a case of Dr. Pugh's²⁰ a similar diagnosis of scorbutic infantilism was suggested when it was shown in the Orthopaedic Section of the Royal Society of Medicine.

Renal Dwarfism.—Chronic nephritis may be associated with, if not the cause of, several conditions of interest to us. First, dwarfism and infantilism. To these may be added changes at the epiphyseal lines similar to those of rickets. As the skiagrams show, these rickety changes may respond

to appropriate treatment as they do in ordinary rickets (*Figs. 111, 112*). I have known such improvement to be followed by a relapse which again yielded to sunlight and other treatment. Lastly—and I think we only see these changes in cases going downhill fairly rapidly, and when the bones are decidedly atrophic—abrupt deformities occur as a result of fractures, partial

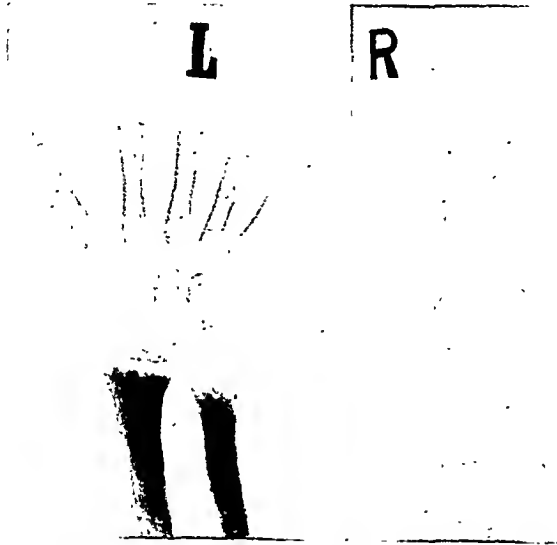


FIG. 111.—Renal rickets in a boy, age $5\frac{1}{2}$ years, showing marked changes at epiphyseal line.

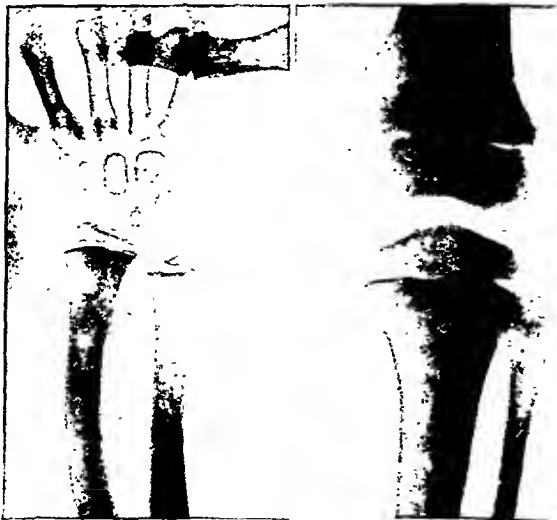


FIG. 112.—Same case as *Fig. 111* three years later, showing epiphyseal changes healed.

or complete, near the ends of the diaphyses of the chief bones of the limbs. Even when complete they may be remarkably painless. There is always a considerable piece of metaphysis left on the epiphyseal side of the fracture. Syphilis is the only disease I know of which gives rise to softening and yielding at this particular point in several bones. Are the changes secondary to the nephritis, or are they both (as seems more likely) the result of a common infective cause?

Cœliac Disease.—Judging only from the few cases of this disease I have been called upon to treat for deformities, the bone changes do not appear to be quite like rickets. The two skiagrams (Fig. 113) are of the same knee.

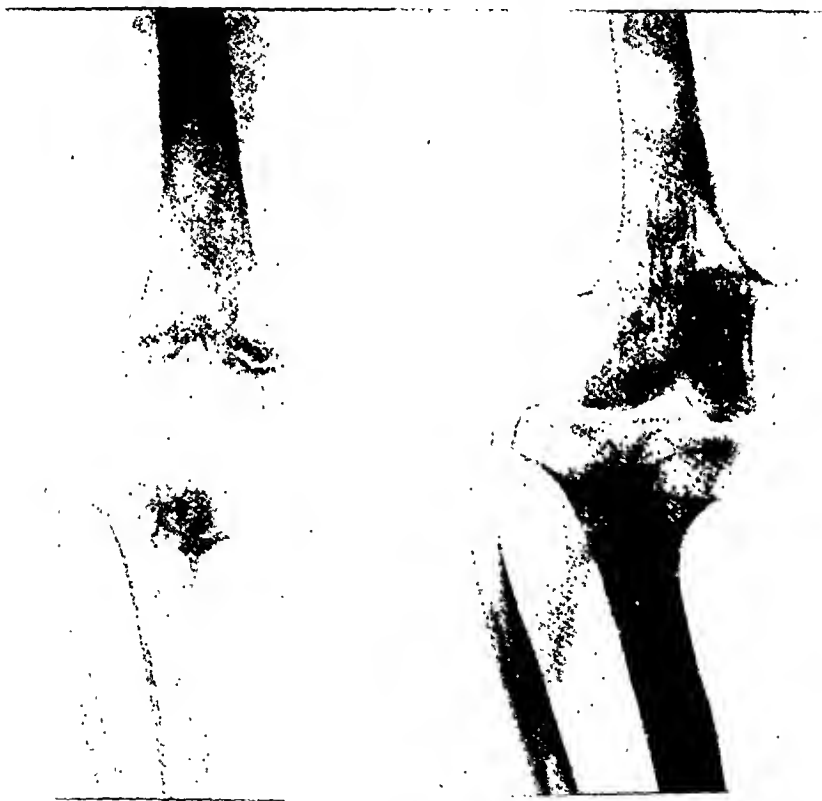


FIG. 113.—Cœliac disease in a girl. Skiagrams of right knee-joint taken at ages of 7 and 17 years respectively.

They were taken at the ages of 7 and 17 respectively. Are these bone changes the result of the disease or of the treatment? Are we to attribute them to the faulty digestion and absorption of fats or to the great reduction of fat in the diet ordered by the physician? It may be noted that great weakness of the lower limbs may occur in this disease, and even loss of the knee-jerks.

ENDOCRINE ERRORS.

Table II shows the main types of disordered growth that result from disturbance of internal secretion so far as our present knowledge goes. It is compiled from the writings of Tidy,²¹ Garrod,²² and Gilford²³ respectively. It is impossible to enter into a discussion of all these various conditions, but a word or two may be said about some of the less known types. The Lorain

Table II.—GENERAL DISORDERS OF THE SKELETON DUE TO ENDOCRINE DISTURBANCE.

| GLAND AFFECTED | | TYPE OF DISTURBANCE | | | | | RESULT |
|-----------------------------------|----|---------------------|----|-----------------------------|----------------------------|----|--|
| <i>Pituitary</i> Anterior lobe | { | (1) Over-secretion | { | (a) Before growth ceases .. | (b) After growth ceases .. | | Gigantism Acromegaly |
| | | (2) Under-secretion | { | (a) Before puberty | (b) After puberty | | Lorain type of infantilism Nil |
| Posterior lobe | { | (1) Over-secretion | .. | .. | .. | .. | Nil |
| | | (2) Under-secretion | .. | .. | .. | .. | Diabetes insipidus |
| Whole gland | | Under-secretion | .. | .. | .. | .. | Fröblich's syndrome |
| <i>Thyroid</i> .. | | Under-secretion | .. | .. | .. | .. | 1. Cretin 2. Brissaud's type |
| <i>Suprarenal</i> .. | | Under-secretion | .. | .. | .. | .. | Infantilism (? mollities ossium) |
| <i>Pineal</i> .. | | Under-secretion | .. | .. | .. | .. | Gigantism plus pre- cocious sexual development |
| <i>Ovaries</i> .. | .. | .. | .. | .. | .. | .. | Osteomalacia |
| <i>Unknown cause</i> | .. | .. | .. | .. | .. | .. | Progeria |

type suggests a small adult, is not fat, and is sexually infantile. The limbs and bones are slim. The epiphyses do not unite, or only do so very late. The Brissaud type of infantilism, on the other hand, displays a round fullness of the soft parts and a large head. All the types mentioned, except those associated with gigantism, are commonly, though not invariably, connected with dwarfism. Progeria is the name given by Gilford to a dwarf displaying a mixture of infantilism and senility. The inclusion of a suprarenal type depends on the fact that certain cases have shown remarkable improvement on the administration of suprarenal extract.

Mollities Ossium and Osteomalacia.—These are so rare in this country that it has been found almost impossible to study them. An occasional radiogram has convinced us that there is a disease of childhood in which the pelvis

and other bones are unduly soft, so that they yield to the normal pressure which they should be able to resist, without there being any signs which warrant a diagnosis of rickets, osteogenesis imperfecta, or fibrocystic disease. It is interesting to note that cases of this disease, *mollities ossium*, which is an acquired and sometimes a painful affection, have been cured by the administration of adrenalin. As to osteomalacia, it would seem that in India, where it is common, it is almost inextricably mixed up with late rickets (*see* Hutchison and Miss Stapleton²⁴). The great rarity of the disease in this



FIG. 114.—Osteomalacia. Hands of a woman, age 46 years.

country warrants including a skiagram of the only adult case I have had the opportunity of examining. The subject was a woman of 46 who had had nine children. The disease began with swelling and pain in the feet when carrying the last but one child, eight and a half years before she was seen. She never got well after this pregnancy, and symptoms came on again with the last pregnancy seven years ago, with pain and stiffness in the legs and spine. Recently she had been losing the use of her hands, and these swelled if she tried to use them much. An attack of bronchitis three months ago had made her worse, and she had been unable to walk since. The skiagrams show general abnormal translucency of practically all the bones, with thinning of the cortex,

the typical deformity of the pelvis, and very curious irregular decalcification in the hands (*Fig. 114*). The phalanges, which show a clear band in the shaft adjacent to the irregular band of increased density, look as if they could be fractured with ease. There is some loss of definition of the joints. The essential change in this disease would seem to be a halisteresis, or simple decalcification, though according to Dawson and Struthers²⁵ there is later some "bone apposition which remains osteoid during the period of the disease".

AFFECTIONS OF UNKNOWN ORIGIN.

Osteitis Deformans.—Of the affections of which the cause is unknown, we can only refer to one, osteitis deformans, which is of interest in connection with what has been said of striation of the bones and dyschondroplasia. Thurstan Holland²⁶ has called attention to the curious striated appearance of some of the bones in osteitis deformans when they themselves are not affected by the disease, and says these changes are probably some of the earliest in the disease (*Fig. 115*). A foot may show very marked striation when the tibia of the same leg shows the typical changes of osteitis deformans.



FIG. 115.—Osteitis deformans. Woman of 70 years. Foot showing striation of bones.

It is often said that the tibia is lengthened in this disease. This is only true in a sense, in that the affected bone takes a curved course instead of a straight one, but the distance between the knee and ankle is not increased; if anything it is diminished. I cannot agree with those who say that no distinction radiographically can be made between osteitis deformans and fibrocystic disease, though I admit the existence of many border-line cases. The connection of the parathyroids with this and other allied affections I cannot deal with. I will only say that so far as Paget's disease is concerned I cannot as yet discard the infective theory. Before leaving this subject may I refer to a letter I received from the late Dr. Robert Lovett shortly before his death.

In the letter he mentions some experiments he was interested in at the time, in which monkeys were fed on vitamin-free diets. One of these monkeys developed typical Paget's disease. He then discovered that three monkeys in the Philadelphia Zoo had developed Paget's disease. Dr. Clark, who reported this occurrence, suggested that osteitis deformans might be a deficiency disease, at one stage at any rate.

The subject of this paper is so immense that one has found it hard to know where to begin and harder still when to stop. The breadth of the subject is the only excuse for what must seem but a disjointed series of observations. Instead of clearing the air, these few remarks may only have added to the fog. If we have managed to interest you by a point here and there, and, perhaps, to stimulate some of the members to devote themselves to the study of the difficult problems with which the subject abounds, we shall feel that our poor efforts have not been entirely in vain. In conclusion an expression of deep gratitude is offered to the colleagues and others who have permitted such free access to their eases, and particularly to Dr. Bertram-Shires, who has been responsible for the majority of the radiograms.

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A CASE OF EFFUSION INTO THE LESSER SAC OF THE PERITONEUM ASSOCIATED WITH GALL-STONES, AND TREATED BY POSTERIOR DRAINAGE.

BY GEORGE T. MOWAT, GLASGOW.

OUR knowledge of the pathology of cystic conditions in the neighbourhood of the lesser sac is necessarily uncertain, because these cases are, as a rule, amenable to the simple treatment of drainage, and, as the mortality is small, the number of pathological investigations which can be carried out is restricted. Meanwhile the classification is far from satisfactory, the attempt to bring all these conditions under the definition of 'true and false cysts of the pancreas' being one which is only justified by lack of more detailed knowledge on the subject. That in a large number of cases these cysts are of pancreatic origin there can be little doubt. True cysts of the pancreas, retention or otherwise, effusions into the lesser sac from pancreatic inflammation or injury, must account for the majority of cases; but there is also little doubt that accumulations of fluid in the lesser sac may occur in which the pancreas plays the rôle of an interested but inoffensive neutral. Jordan Lloyd showed that clinically these accumulations closely resemble true cysts of the pancreas of large size. Opie has shown that true pancreatic cysts are lined with epithelium; the retro-peritoneal pseudo-cysts due to injury of the pancreas are lined with connective tissue; while effusions into the lesser sac must necessarily be lined by peritoneal membrane. With this in view, examination of the lining and excision of a small piece of the wall of the sac for microscopical examination should be of help in diagnosis.

While the presence of pancreatic enzymes in the fluid in the lesser sac definitely incriminates the pancreas, it is more difficult in the absence of those enzymes to exclude the pancreas altogether as an exciting cause. The following is a case of effusion into the lesser sac associated with gall-stones and inflammatory adhesions around the cystic duct and the foramen of Winslow, where the pancreas was found to be normal and there was evidence of the irritation being a direct spread from the biliary passages.

M. R. was a married woman of 40, and had had no previous illnesses. In February, 1926, she began to have periodic attacks of vomiting, which had no relation to the taking of food. Later, vomiting became more frequent, though still without relation to food, until, at the time of her admission into hospital in April, 1926, she was vomiting at least once daily. From March, 1926, up till the time of admission, she complained of a fixed discomfort in the epigastrium, chiefly on the left side and unaffected by intake of food or by vomiting. She also noticed that her waist was becoming larger. There was nothing in her history, past or present, suggesting biliary or pancreatic disease.

For the past three months she had been growing more constipated and was losing weight rapidly.

ON ADMISSION.—She was admitted to hospital on April 5, 1926, pale, anæmic, and with a visible rounded enlargement of the upper abdomen. On examination there was tenderness on pressure over the left rectus region of the epigastrium, and a smooth, tense, rounded mass was found to occupy the upper part of the abdomen. Its limits were as follows: To the right, it ended in a rounded border at the outer edge of the rectus muscle; to the left, it filled the whole of the left hypochondrium and part of the left lumbar region; below, it extended to 2 in. below the umbilicus, where a smooth, curved margin ran from the outer border of the right rectus to the loin; above, it disappeared below the costal margin. The limits seemed to be typical of an accumulation of fluid in the lesser sac of the peritoneum. No tenderness was present over the gall-bladder, and the tests for pancreatic inefficiency were all negative.

OPERATION.—On April 7 she developed thrombosis of the left femoral vein, and it was not until April 19 that operation could be undertaken. A median incision was made in the epigastrium, and the tumour, about the size of a Rugby football, exposed. The stomach ran round its convexity in the form of a flattened band, $1\frac{1}{2}$ in. wide, while the transverse colon was attached along its lower border. Above, it extended behind the liver to the vault of the diaphragm, and, to the left, it filled the left hypochondrium and lumbar regions. A cannula was inserted through the gastro-hepatic omentum, which was 6 in. in length, and four pints of clear serous fluid were evacuated. The opening was then enlarged and the cavity was found to be the lesser sac, lined with peritoneal membrane. The pancreas to all appearance was normal, and no induration or evidence of chronic pancreatitis was found. The stomach and transverse colon were free from disease. Examination of the biliary tract revealed a small thickened gall-bladder bound down to the liver with dense pearly-white adhesions. The same type of adhesion was present round the cystic duct, and was well-marked in the region of the foramen of Winslow, which was closed. The gall-bladder was opened and about thirty stones removed from both it and the cystic and common bile-duets. The gall-bladder was drained and the opening of the gastro-hepatic omentum was sutured. Examination of the bile showed it to be sterile, and the gall-stones were composed entirely of crystals of lecithin and cholesterol, also sterile. The fluid from the sac was sterile, free from pancreatic enzymes, and of the composition of ordinary serous exudate. Three weeks later the abdominal wound was healed, but the sac was filling up again. On May 19 a 5-in. incision was made, running outwards parallel to and $\frac{1}{2}$ in. below the twelfth rib, on the left side. It began at the outer border of the erector spinæ, and extended outwards and slightly upwards. The latissimus dorsi and external oblique muscles were cut superficially, and the tendinous interval between the quadratus lumborum and the internal oblique and transversalis muscles was sought. This was incised, and the internal oblique and transversalis muscles were cut in a forward and slightly upward direction. Only the transversalis fascia, as it ran inwards to cover the quadratus lumborum, now intervened. This was incised in the direction of the wound, and the last rib was pulled upwards

with a broad retractor. The spleen was displaced forwards, and the kidney backwards, when the lieno-renal ligament bulged downwards into view. The lesser sac was incised through this, and a tube of 1 in. diameter was inserted.

Convalescence was prolonged until September by thrombosis of the right femoral vein, and by a small sinus which persisted for over two months. When seen in January, 1927, both wounds were soundly healed, and there has been no recurrence of fluid in the lesser sac. She is well and is putting on weight rapidly.

SUMMARY.

1. The fluid was definitely contained in a sac, the wall of which was lined with peritoneal membrane, and which conformed to the usual boundaries of the lesser sac. It was serous fluid containing no organisms or pancreatic enzymes.

2. The pancreas was uniformly normal; there were no patches of thickening, no cysts, nor anything to suggest a pancreatitis secondary to the biliary condition.

3. The presence of dense adhesions around the upper end of the common bile-duct, blocking the foramen of Winslow, and unassociated with any symptoms, suggests a low type of inflammatory condition which spread directly to the lining of the lesser sac, giving rise to slow effusion.

4. While marsupialization of a true pancreatic cyst is an efficient method of treatment, an accumulation of fluid in the lesser sac presents a different problem. The irregular shape of the sac, with the long subphrenic pouch, extending behind the liver, makes drainage a less simple matter, and the infection which follows marsupialization gives rise to the unpleasant prospect of a posterior subphrenic abscess. Drainage through the anterior abdominal wall, while efficient in the smooth, round, true pancreatic cyst, is less likely to be so efficient in lesser sac effusions of irregular shape, and the posterior incision affords, in the semi-recumbent position, a drainage at its most dependent part, the posterior surface low down and to the left. Anterior drainage, unless the patient is kept in the prone position, is of the overflow type, and, for obvious reasons, must be less efficient than drainage posteriorly, which is easily done and gives all the requirements of a true drainage.

VISITS TO SURGICAL CLINICS AT HOME AND ABROAD.

THE SURGICAL CLINICS AND HOSPITALS OF MADRID.

THE medical world of Madrid is summed up to the average British medical man in the world-renowned name of Ramon y Cajal. There is, however, much activity going on, and, so far as surgery is concerned, a band of workers is busy in Madrid who, with the modern hospitals at present under construction, will rapidly bring Spanish surgery into the front rank of their European and American colleagues.

It may have been the language difficulty which has prevented the British surgeons visiting the Madrid clinics in the past; they can rest assured that this difficulty is compensated by the welcome they will receive, and that surgery, like all true art, is universal, and needs very little language which is not common to all its votaries. The interest of their Majesties the King and Queen of Spain in hospitals, and indeed in everything which affects the welfare of their people, is well known. Their relationship alone with Great Britain would assure the British surgeon of a warm welcome in the surgical clinics of Spain. Such was the case, indeed, when recently a number of British surgeons spent a week in Madrid. They visited the various hospitals—old, new, and those under construction; the various pathological institutes; also institutes for re-education of the injured. These latter are not only hospitals for the treatment and recovery from immediate injuries, but also institutes in which an injured man recovers that peace of mind which assures him that, though injured and in some sense crippled, he is not altogether an odd lot in the general labour market. In this respect the hospital authorities of Great Britain might learn much from their Spanish colleagues: but the whole question will be gone into more fully later.

The old hospitals of Madrid are naturally situated in the older quarters of the town. The newer hospitals and those under construction are on the outskirts of the city and in the neighbourhood of the proposed University city, the realization of which is so near to the heart of the King and Queen. The authorities are adopting the course of building new modern hospitals on beautiful sites, where there is ample room for expansion on the pavilion system, rather than making abortive efforts to remodel old buildings on already overcrowded sites.

They have evidently given up the idea, which is now so truly old-fashioned, that it is necessary for a hospital to be situated in the midst of its clientèle. Where is the clientèle of a modern hospital situated nowadays? A small hospital of the nature of a casualty clearing station will meet all immediate emergency requirements.

The Princessa Hospital.—On Monday, April 19, three clinics were visited at the Princessa Hospital (*Fig. 116*), namely, those of Dr. Cifuentes, Dr. Blanc Fortacin, and Dr. Slocker. The Hospital is a State hospital containing 350 beds; those patients who can afford to pay towards their maintenance are expected to do so; the sum is about ten pesetas a day (i.e., fifty shillings a week).

SUPRAPUBIC CYSTOSTOMY.—Dr. Cifuentes is the urologist. The operation seen was a suprapubic cystostomy for drainage, as a preliminary to removal of the prostate at a subsequent date. The preliminary investigation of the patient had been very thorough. A regular printed questionnaire is used for each case, profusely illustrated with diagrams of the genito-urinary system, so bringing home forcibly to the student that the system must be considered as a whole, rather than as a series of independent organs. The skiagram of the genito-urinary system of the case was negative.

Operation 9 to 9.30. The head and feet of the patient were both lowered so as to make the lower abdomen prominent. Local anaesthesia was used—0.5 per cent novocain. After infiltration the skin was incised longitudinally. The sheath of the rectus was then infiltrated, opened, and the wall of the bladder exposed. This was then infiltrated with novocain. Two silk ligatures were passed through the bladder to act as tractors, and the bladder was opened longitudinally between them.

To the surprise of the operator, assistants, and onlookers, twelve stones were present in the bladder, the largest the size of a pigeon's egg, the smallest that of a marble. The stones were uric acid. The bladder was drained with a wide-bored Marianne's tube, with a small tube attached laterally for lavage.

A series of skiagrams was demonstrated illustrating the use of pyelography for distinguishing kidney tumours from other abdominal tumours, especially the tumours of the spleen.

Dr. Blanc Fortacin is the gynaecologist; he did a supravaginal hysterectomy for a large fibroid.

SUPRAVAGINAL HYSTERECTOMY.—*Operation 9.55 to 10.40.* The anaesthesia was intrathecal by tropacocaine. Catgut was used throughout for ligatures. The cervical canal was sterilized with the actual cautery and not closed.

Dr. Slocker specializes in abdominal surgery, especially that of the stomach. We saw him do two operations.

1. POSTERIOR GASTROJEJUNOSTOMY FOR DUODENAL ULCER.—*Operation 10.45 to 11.5.* The anaesthesia was by closed ether. The abdomen was opened



FIG. 116.—The Princessa Hospital, Madrid.

in the middle line and the lesion demonstrated. The usual posterior no-loop gastrojejunostomy was done, except that three layers of sutures were inserted both anteriorly and posteriorly, all of catgut. The first layer took the serous coat only, the second the seromuscular coat, this being put in before the mucous membrane was opened. Clamps were used both for the stomach and jejunum, and straight needles. The abdomen was not otherwise explored. The abdominal wall was closed in layers, the skin being united with Michel clips.

2. SUPRAVAGINAL HYSTERECTOMY FOR FIBROID.—*Operation 11.20 to 12.5.* Intrathecal anæsthesia by tropæocaine was used. The case presented great



FIG. 117.—The Orthopædic Hospital and Institute, Madrid. Front view.

technical difficulties owing to deformity of the pelvis and the presence of a double pyosalpinx. The cervical canal was closed with thick catgut. An omental graft was placed over the sigmoid colon where the pyosalpinx had been adherent. Faure's needle was used for the deep pelvic work. The abdominal wall was closed in layers.

The Orthopædic Hospital and Institute, which we are enabled to illustrate in Figs. 117–120, for re-education of the injured, is situated on the

outskirts of Madrid. The literal translation of the address is 'beautiful view', and the situation deserves it. The work done is excellent. We were conducted round in a most thorough and courteous manner by the director, Dr. Oller.

The building might be described as a new old one. It was built in 1816, and for many years was a private house belonging to the Marquis of Salamanca; later it was used as a workhouse, and indeed a part of the building is still occupied by the indigent aged. For the last four years, much enlarged and brought up to date, it has been used for its present purpose.



FIG. 118.—The bookbinders' workshop.

There are 250 beds, complete with X-ray department, suite of rooms for operations, massage, etc.

It receives patients from all parts of Spain: locally, often immediately after the accident; more often those from a distance only months, or even years, after the injury. The cases, therefore, resolve themselves into the two classes so well known in our own country—those who have never been allowed to drift away from expert treatment, and those who have often by chance drifted towards it, perhaps too late for anything to be done. It must therefore be judged by its successes rather than condemned by its failures.

We visited first the wards and then the library. The latter is decorated in the Moorish style of the Alhambra, the coolness and shade being very necessary. All the representative surgical journals seem to be on the shelves. The books were evidently being chosen with great care, and there would be very few surgical subjects which could not be readily referred to.

We next visited the theatre, where plays are given both for and by the patients; they also have cinematograph entertainments and lectures. The director rightly considers this a very important asset to promote the recovery of the patients.

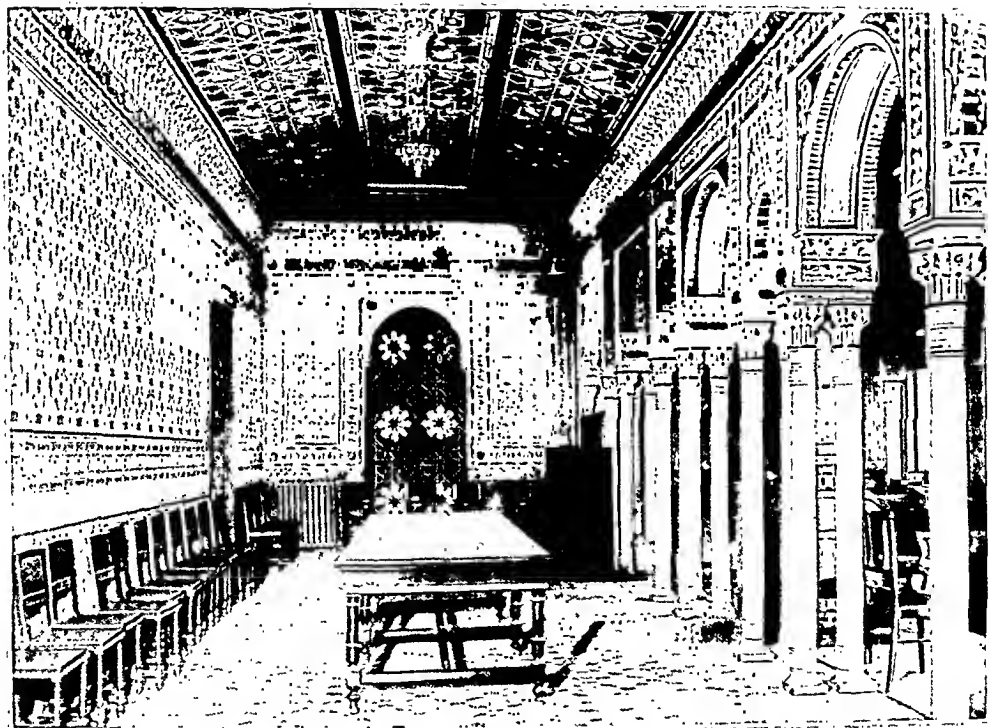


FIG. 119.—The library.

We were then shown round the school. One of the main difficulties with which the director has to contend is the illiteracy of many of the patients. Here the illiterate are taught to read and write, and the literate taught the essentials of mechanics, drawing, etc., so that they can be fitted for one of the main objects of the Institute, namely, the re-education of the patient in some trade or calling by which he has a fair chance to keep himself by getting work in the general labour market.

The finances of the Institute are supported by the Ministry of Labour, which pays at least 400,000 pesetas a year (about £16,000) towards the

upkeep of the Hospital. Everything made in the Hospital is sold, and this brings in a further 60,000 pesetas a year (about £2400). In addition, the patients, if possible, pay a small amount towards their maintenance. Apparently the works at which the man was injured do not have to pay towards his maintenance in hospital, though the injured man does receive compensation up to 35 pesetas a week (27s.) towards the maintenance of himself and his family. There is, however, nothing comparable with our schemes of workmen's contributions to the hospitals, nor contributions by employers, because most are State-aided hospitals.

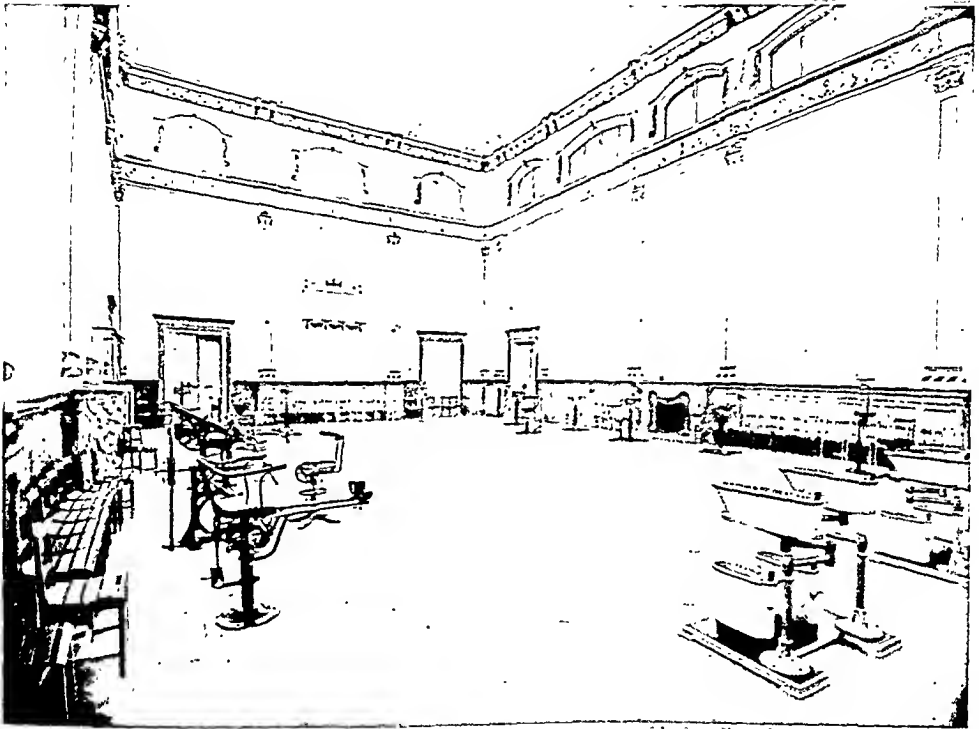


FIG. 120.—The hall for mechano-therapy.

The Institute is fitted with a very complete remedial exercise and gymnastic department attached to the massage and electrical departments. The director is a great believer in the 'Zander' method of remedial exercises.

The workshops for instructional purposes were under the charge of an overseer who spoke excellent English and had been employed as an engineer by Messrs. Vickers & Co. Ltd. in England for many years. He has to make a personal study of each man so as to form an idea of what type of work he is fitted for, and also whether or not it is quite impossible for him to do his old work after suitable re-education. Naturally as far as possible a man is put to his own or some kindred trade. In some cases this is quite out of the

question. He then has to be completely retrained. The occupations for which he can be re-educated include boot making and repairing, fitting, milling, wireless work, electrical work, wood-working, furniture making, leather working, book-keeping, etc.

The wood-working and furniture-making departments appeared very complete and the instruction very thorough. The men are first taught how to use their tools, then to make models of the proposed furniture, and finally make the ordinary pieces; some shown were excellent in make and quality.

Many of the patients being trained are not in-patients, but live in the vicinity and attend for treatment and instruction. It is often necessary that they should go to the school. These men attend the Institute at 8 a.m., and on three days a week go to school for two hours each day and on the other three days for four hours. At first, while he is learning, the patient gets 6 pesetas a week, and this is advanced gradually according to his skill. When he can earn 44 pesetas a week (about 30 shillings) by working eight hours a day he is sent out to a job if one can be found for him; otherwise, he must take his chance in the general labour market. Employers of labour, it is found, do not give these men preferential treatment; there are a few, however, who, as in this country with ex-soldiers, will accept a certain number.

As with all these schemes, it is found that the personal factor, and the 'will to work' asset of the individual member, determine the success or failure of the case. It has been found that the time necessary for retraining varies considerably—from a few months in a case of boot-repairing to two years for electrical or wireless work, and three years for book-keeping.

All the splints and surgical appliances used in the Institute are made in the workshops. The artificial limbs for the lower extremity above the knee-joint sell for about £17 in the general market, and appeared to be very well-constructed, light, and efficient.

There was an air of camaraderie about the whole Institute; all the men observed at work were obviously trying to do their best in spite of their disability. The atmosphere of competition, so to speak, seemed to have improved the morale of the men.

One knows of no similar hospital in this country except the tuberculosis colonies of Papworth and other similar places. In these latter, however, it is assumed that the man will never be able to take his chance in the general labour market. He is trained to regard himself as an 'odd lot'. In this Institute the men are encouraged not to regard themselves as in any way an 'odd lot', but to look forward to the day when they can compete on level terms with their fellow-men so far as the quality, efficiency, and speed of their work is concerned.

The New Military Hospital of 2000 beds in 30 pavilions is also situated on the outskirts of Madrid. Transport is so organized that the wounded are in this hospital within three days from the line in Africa. It is complete with surgical, medical, ophthalmic, aural, infectious, and dermatological sections. It has a very complete pathological and operation suite, and

remedial and re-education departments. The ideal of the Hospital is summed up in the statue that meets the visitor on his entrance—a wounded soldier breaking his crutches across his knees—exquisitely executed in bronze.

We were conducted round by the officer commanding and the chief of the surgical section, Dr. Bastos. The cases shown bore witness to the efficiency of the work. There were especially two cases of cineplastic amputation of the arm. In one, a man with the arm amputated just below the shoulder-joint, the artificial hand could be opened and shut with ease, also small objects picked up and held between the thumb and forefinger.

The cases of paraplegia from gunshot wound of the spinal cord with retention of urine were being treated by leaving alone and expressing the bladder contents by hand every two hours, until automatic control was established. No catheterization or suprapubic drainage was used.

The University Surgical Clinic of Madrid at the San Carlos Hospital.—This is a large general hospital, and takes as in-patients not only accidents and those cases admitted in the ordinary way from all over Spain, but any case admitted to the other hospitals in Madrid, which is thought to be of value for students, can be transferred there. The Hospital is closed down for three months during the hot weather and summer vacation, and the cases remaining are distributed into the other hospitals of the city.

The surgical clinic of Professor Doctor Cardinal is a busy one, judging by the list of operations for Wednesday, April 20. There were three gastric cases diagnosed gastric ulcer, two cases of appendicitis, one of cholecystitis, and seven hernias. These, with a hæmorrhoid case, made up a list of fourteen operations to be done between 9 a.m. and noon.

Three tables were in use at the same time, and the work was silently, efficiently, and deftly performed.

1. **CANCER OF PYLORUS** (Gastrectomy by Professor Cardinal).—*Operation 9.30 to 10.25.* The anaesthesia was pure chloroform administered by the drop method. The skin was cleaned by ether, and then iodine was used. The incision was made through the middle line. The greater curvature of the stomach was first freed, then the lesser curvature, and the stomach then divided. The duodenum was clamped with crushing forceps, and the crushed area tied tightly with silk. A purse-string suture of silk was passed round the duodenum distal to the silk ligature. The duodenum was divided by the actual cautery, and the cut end invaginated. The raw surface of the pancreas was shut off with an omental graft. The union of jejunum to stomach was by the posterior Polya method, proximal end to greater curvature, the intestine being opened by the actual cautery.

The ligature and suture material was silk throughout; the suture line of the gut was always begun in the middle, so that the knots were never at the periphery. The abdominal wall was closed in layers, silk being the suture material used.

2. **OPERATION FOR CHOLECYSTITIS** (Professor Cardinal).—*Operation 10.25 to 10.45.* The anaesthesia was by pure chloroform administered by the drop method. No gall-stone pillow was used, nor any rest to push the upper

abdomen forward. The dissection of the gall-bladder from the liver was done from above downwards. The cystic artery and duct were tied in one catgut ligature, the duct being divided with the actual cautery. The abdomen was closed with no drainage.

The appendicectomies were done through gridiron incisions. The hernias were done by the Koehler method of treating the sac.

Professor Olivarez did three operations:—

1. FOR A DUODENAL ULCER in a man 39 years old. He had a typical history extending over twelve years, and recently had had symptoms of pyloric stenosis superimposed. The X ray showed a dilated stomach with delay in emptying. The operation done was that of partial gastrectomy. *Operation* 11.5 to 12.15. The anæsthetic was ether given by an inhaler. The stomach was first separated along the greater curvature. De Martel's clamps were used both for the stomach and duodenum. The jejunum was joined to the stomach by the posterior Polya method, the proximal end of the jejunum being put to the lesser curvature.

2. FOR HYDATID CYST OF THE LIVER.—*Operation* 12.25 to 12.50. The anæsthetic was ether given by an inhaler. The incision was made through the rectus, the cyst exposed, and the surface moistened with 5 per cent formalin. The cyst was then aspirated and 5 per cent formalin injected. After being emptied, the cyst was marsupialized and drained.

3. CHOLECYSTECTOMY FOR GALL-STONES.—*Operation* 12.55 to 1.15. The anæsthetic was ether given by an inhaler. The incision was made through the rectus. The gall-bladder, which was firmly adherent to the stomach, was dissected free. The cystic duct was defined, tied, and divided. The gall-bladder was then removed. A tube was placed down to the stump of the duct. The abdomen in all these cases was closed in layers, catgut being used for the deeper ones.

Professor Don Sebastian Recasens, the Dean of the Medical Faculty of Madrid, is the professor of gynæcology at the University. It was entirely due to his unfailing energy and courtesy that the visitors were enabled to see so much of the work in the surgical clinics. He performed three operations:—

1. FOR DISEASED APPENDAGES.—The case had a long history of pain and discomfort. He explored the pelvis through the usual mid-line incision. He removed the left ovary and tube, but was able to save the right. He had to deal with a considerable raw area on the pelvic colon. He removed some omentum, had it melted down in the theatre, and poured the liquid fat over the raw area. He stated that he had been doing this for a number of years, and thought it was the surest way to prevent the adhesions re-forming.

2. MYOMECTOMY FOR FIBROID OF THE UTERUS.—The case presented no unusual feature. The Professor stated that he considered myomectomy the operation of choice.

3. HYSTERECTOMY FOR FIBROSIS OF THE UTERUS WITH MENORRHAGIA.—The abdomen was closed in all these cases in layers, using catgut for the deep and silkworm gut for the superficial layer.

The Medical School.—The motto of the Medical School of Madrid is “Nunquam sine anatomica artem chirurgicam possidebis”, and the course

for the medical student supports this, as more stress is laid upon anatomy than physiology.

The medical student usually 'enters' on his course at the age of 16 years. The first year is spent in the Faculty of Science doing chemistry and physics. At the end of this year, and after passing the necessary examination, he enters the Faculty of Medicine. The course in the Faculty of Medicine lasts six years. The first year is given up entirely to anatomy, doing the usual dissections and attending lectures. He also does his course of microscopical anatomy this year under the direction of the famous Professor Ramon y Cajal.

The second year is spent doing anatomical dissections and physiology, both practical and lectures. The third year is spent at pathology, general and special; also attending a course of therapeutics, both lectures and practical laboratory work. During the fourth year he attends classes of instruction in clinical methods. The fifth and sixth years are given up entirely to clinical work. During the fifth year he attends a course and actually does operations on the cadaver, a course described as topographical anatomy. There is an examination at the end of each year which must be passed before he is allowed to proceed to the next year's work.

There are three professors of general surgery in the University of Madrid; they incline, however, to specialize—e.g., one is interested mainly in urology, another in abdominal surgery, and a third in the surgery of fractures and the cranium.

Each professor has six whole-time assistants. The assistants are appointed after open competitive examination, and each step of the interne's career is dependent upon passing competitive examinations. The professors also have to sit for an examination organized by the Ministry of Education before being appointed to the chair. All so-called honorary and professorial appointments are made only after competitive and public examination. We did not ascertain if there is a time limit for a professor as regards age.

There are about 3000 medical students in Madrid University. There are also about thirteen other Universities in Spain having a medical faculty and students attending the courses. So far as we could understand, all the medical education is free; only the examination fees have to be paid by the student.

There is nothing comparable to the National Health Insurance Act in Spain so far as regards the prospects of practice for these students after they are qualified. It appears that the classes of Spain are divided, so to speak, very horizontally into upper and lower classes. There does not seem to be what one might call the bourgeois element, or the lower and upper middle class.

The people all belong to large medical-aid societies to which they pay varying sums according to the benefits received, including burial. It could not be ascertained whether these medical-aid societies paid anything to the hospitals. They probably do not, as the hospitals are almost all State-aided.

In private practice the municipalities pay the doctors for the poor. The other people all belong to clubs and medical-aid societies. Practices are not bought or sold, but in every district there are private polielinics which young men are invited to join, and as years go on they draw a larger share of the profits.

St. Adela Hospital.—A visit was paid on Wednesday, April 20, to the Hospital of St. Adela. It is a hospital supported by the Spanish Red Cross and sometimes called the Queen's Hospital, as Her Majesty the Queen has a particular interest in it. We were shown round by the director, Dr. Victor M. Noguerras, who is justly proud of the new hospital which is under course of construction.

It is a general hospital, thoroughly equipped for surgical work only, both as regards out- and in-patients. It is the training school for lay nurses, both V.A.D. and fully trained, under the auspices of the Red Cross Society. The training for a V.A.D. is six months, for the professional nurse two years. Next year it is said that the eldest daughter of their Majesties will do the complete V.A.D. training.

The Cancer Research Institute.—We were conducted round the Alfonso XIII Institute for Cancer Research by the director, Dr. Joseph Goyannes. It is a new Institute, having been opened four years ago, and is situated on the outskirts of Madrid in the vicinity of the proposed new University City. There are at present 32 beds, but in two years' time it is hoped that extensions will be completed and 200 beds will be available.

This Institute, as well as being probably one of the most modern in Europe for the investigation of cancer, is a hospital completely equipped for its treatment. It is also a centre for the anti-cancer propaganda of Spain.

The State supports the Institute, paying 100,000 pesetas a year (about £4000). The patients pay $12\frac{1}{2}$ pesetas a day (10s.) towards their maintenance. There is an out-patient department, open three days each week, and cases are sent to it from all over Spain.

X-ray treatment is given as a preventive after the operative treatment. In carcinoma, small and frequent dosage has been found to be more beneficial than massive doses.

The Instituto Rubio.—This hospital, which we next visited, contains 60 beds, and is used mainly for the training of lay nurses and as a post-graduate clinic for medical men of Madrid and district.

The General Hospital was visited on Friday, April 22. This is one of the old hospitals of Madrid. The wards are large and broad, some of them containing seventy-two patients in four rows. It is situated in one of the crowded quarters of Madrid, and must be an extremely busy general hospital.

Four surgeons were seen at work in their clinics. Dr. Gimenez did three operations :—

1. GASTROJEJUNOSTOMY FOR DUODENAL ULCER.—*Operation 9.20 to 9.53.* The operation was of the posterior, no-loop type; silk was used for suture of the serous coats, and catgut for the mucous membrane. The abdominal incision was closed by through-and-through wire sutures.

2. APPENDICECTOMY through a gridiron incision.

3. REMOVAL OF EPITHELIOMA OF TONGUE and the glands of the sub-maxillary triangle of the neck on the same side. The half of the tongue was excised by the usual intrabuccal method.

Dr. Pelaez is the abdominal surgical specialist of the General Hospital. He does gastric surgery principally. We saw him do three partial gastrectomy operations for ulcers :—

1. GASTRECTOMY FOR CANCER OF THE PYLORUS.—*Operation 9.30 to 10.35.* The anæsthetic was pure chloroform. The greater curvature of the stomach was first freed, then the lesser curvature. The duodenum was divided between crushing clamps, the distal end closed by passing a running silk suture over and over the clamp, and then withdrawing the clamp, pulling the suture tight at the same time. The end was then invaginated by a purse-string suture of silk. The jejunum was fixed to the stomach by the retrocolic Polya method, the proximal end of the jejunum to the greater curvature.

2. GASTRECTOMY FOR DUODENAL ULCER.—The ulcer was fixed to the pancreas. The technique was the same as in the previous case. *Operation 10.50 to 11.40.*

3. GASTRECTOMY FOR GASTRIC ULCER on the lesser curvature. The technique was the same as in the previous case.

HYDATID CYST.—Dr. Vigueras operated for a hydatid cyst of the liver in a girl 18 years of age. There was a history of a lump having been present for two and a half years; no thrill was to be felt. A transrectal incision was made and the cyst exposed. Formalin 5 per cent was injected into the cyst, which was then emptied, marsupialized, and drained. The *operation time* was 11.45 to 12.10.

NEPHRECTOMY AND PROSTATECTOMY.—Dr. Covisa is the urologist at the General Hospital. He did two operations—nephrectomy for calculous pyonephrosis, and prostatectomy. For the nephrectomy he used a lumbar incision. The pelvis of the kidney was very dilated, and he had some little trouble with the pedicle. The operation field was quite dry when the operation was completed. In the other case the prostate was removed at this the first operation, the prostatic bed being packed with gauze strips moistened with iodoform. The cases had been thoroughly investigated before operation had been advised.

The Maternity Hospital of St. Maria Christina is a new hospital, and is named after the Queen Mother, who takes a very particular interest in this hospital, and at whose instigation it was built. She gave the ground and some money towards the building, the State paying the rest of the initial expense.

It contains 150 beds; 100 are for obstetric cases and 50 for gynæcological cases. It is also a training school for thirty midwives. There are wards in which the patients pay 6 pesetas a day (about 4/-), the fees for others ranging as high as 18 guineas a week for private rooms with bathrooms attached. These fees are for maintenance only, and do not include medical attendance.

The idea at the conception of the hospital was that it should be self-supporting. This has never been the case yet, and the Government makes up the deficit each year. It is beautifully situated, and excellently equipped with X-ray department, operation suites, pathological laboratories, lecture

rooms, ante-natal departments, etc. It is probably one of the most modern and best-equipped maternity hospitals in Europe. All the patients must be married. There appears to be no provision for the illegitimate mother.

* * * * *

The impression left on one's mind after a visit to the hospitals of Madrid is one of progressive effort towards the attainment of a very high ideal. In Spain, as everywhere at the present time, the hospital service of the nation is evidently engaging much of the time and thought of the authorities.

In Spain it is recognized that the expense is such that the State must be directly or indirectly responsible for much of it; yet it is made clear to the people that some effort on their part is necessary to contribute to their cost of maintenance, and all pay something who can. With the interest which is being taken by the King and Queen, there is no doubt that in a very short time the hospital service of Madrid will be second to none.

The directors of all the hospitals, and the surgeons who were seen at work, are evidently much-travelled and widely-read men, who have a broad outlook, not merely upon their own little corner of medical practice but over the whole field of medical science both in the clinic and the laboratory. Very little is being left to chance, and under the guidance of the Medical Faculty of Madrid, and the energy of their indefatigable Dean, Professor Don Sebastian Recasens, the future of Spanish surgery is assured.

Anyone who wishes to visit these clinics in the future may rest assured that everything will be done to make his task easy and his visit enjoyable.

"BACILLUS WELCHII CHOLECYSTITIS."

We have received the following note from the authors of the article entitled 'A Case of B. Welchii Cholecystitis' published in the April issue of the BRITISH JOURNAL OF SURGERY, p. 646.

"Our attention has been called to the omission of any reference to the case of 'Gangrenous Cholecystitis due to the Gas Bacillus' published by Dr. G. G. Cottam in *Surgery, Gynecology, and Obstetrics*, August, 1917. We regret this want of accuracy in our references the more, seeing that Dr. Cottam's case antedates by some years the two others quoted in the article, and must be considered the first recorded case of the kind in which the bacteriology was completely worked out."

*SHORT NOTES OF
RARE OR OBSCURE CASES*

**A CASE OF CARCINOMATOSIS FOLLOWING
TREATMENT BY RADIUM.**

By JOHN B. HUNTER,

SURGEON TO THE ROYAL NORTHERN HOSPITAL, AND ROYAL CHEST HOSPITAL, LONDON.

THE following case of carcinomatosis is of considerable interest, the secondary deposits having been treated with radium. In 1922 I reported two cases of general vascular carcinoma in which radium had been used in treating growths of the uterus. My opinion was then that in a certain number of cases radium appeared to destroy the patient's natural resistance to carcinoma, and allowed

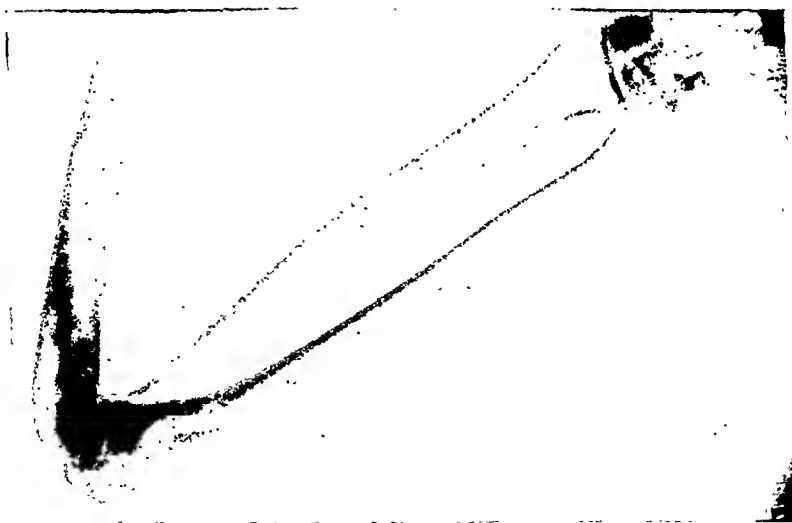


FIG. 121.—Humerus, radius, and ulna, showing growth in humerus and upper end of radius.

circulating carcinoma cells to settle, and start secondary deposits wherever they were carried. Since then I have seen a number of cases treated with radium in which the secondary deposits appeared more numerous, and in more varied positions, than in cases not so treated. This case is an extreme example. It was admitted under Dr. Batty Shaw, to whom I am indebted for permission to report it.



FIG. 122.—Showing condition of ribs, clavicles, and scapulae.



FIG. 123.—The pelvis is completely infiltrated with growth.

B. C., a married woman of 43 years, was admitted to University College Hospital complaining of pains in the chest and abdomen, and glands in the neck which apparently enlarged and decreased in size. She had the scar of a radical breast operation on the right side. In both posterior triangles there were hard glands relatively discrete. On examination of the chest there were



FIG. 124.—The skull, which shows the extensive destruction of bone by the secondary deposits.

patchy areas where breath-sounds were weak. There were no physical signs in the abdomen. Her blood-count showed a secondary anæmia.

On three occasions the glands in the neck were radiated with 100 mgrm. of radium for four hours. Areas of the chest wall were also treated. The dosage and screening were as follows: (1) July 28, 1925: Inner end of left

clavicle and outer end of clavicle—100 mgrm., screened 0.5 mm. platinum, 2 mm. rubber, 4 folds lint, three hours to each place. (2) Sept. 1, 1925: Left breast region, middle of back—100 mgrm., screened as before, three hours each. (3) Dec. 18, 1925: No. 1 repeated. After each application the patient vomited. She had previously had radium treatment at the Middlesex Hospital. A skiagram of the chest showed secondary deposits in the lungs, the scapulæ, and ribs. Two months after admission she developed a nodule in the skin of the chest, and her general condition became worse. Skiagrams of the whole skeleton were taken at this time (*Figs. 121–124*), and showed secondary deposits in the skull, vertebræ, pelvis, humeri, and both femurs, as well as the situations already mentioned, but the peripheral bones appeared normal. Secondary deposits became palpable in both axillæ, the skin of the back, and the left breast. She also developed a pleural effusion on the right side, which was aspirated.

The patient gradually got weaker, and died five months after admission. There was some terminal confusion, but at no time did there appear to be any involvement of the central nervous system.

POST-MORTEM FINDINGS.—The heart showed simple atrophy; there were small secondaries in the parietal pericardium. There was a bilateral pleural effusion and there were secondaries studded over the pleural surfaces, both visceral and parietal. The liver showed numerous secondaries, as did the spleen, and growth was also found in accessory spleens. There was replacement of all but a small portion of cortex of both suprarenals by firm white growth. Secondaries were also present in both ovaries and in the left breast. In the brain there was a firm large mass occupying the anterior lobe. Over the vertex, and less marked in the middle fossa and occipital region, was a thick granular sheet of carcinoma covering the



FIG. 125.—A photograph of the lower end of the right femur in longitudinal section, showing the red marrow and the secondary deposits standing out as white nodules.

bony surface of the dura. The vault of the skull was thickened and worm-eaten on its inner surface, and in two areas there was complete replacement of bone by growth.

In the other bones examined—lumbar vertebræ, ribs, right radius and femur—there was widespread secondary infiltration, and red marrow was present in the lower ends of the radius and femur (*Fig. 125*). In all cases the macroscopic presence of growth was confirmed by microscopic sections.

A CASE OF 'WANDERING SPLEEN' CAUSING INTESTINAL OBSTRUCTION.

BY H. A. H. HARRIS, LONDON.

C. O., MALE, age 27, was admitted to hospital, under my care, on Dec. 14, 1926, his doctor having made a diagnosis of intestinal obstruction. The patient was of an excitable and voluble temperament, and this made the elicitation of an accurate history somewhat difficult.

HISTORY.—The patient stated that he had always had a tendency to constipation and that he habitually took aperients. Constipation had been more obstinate during the past year, while for a fortnight previous to admission there had been no satisfactory evacuation; in spite of repeated enemata, only a few small, hard masses had been passed. The last occasion upon which he had voided any faecal material or flatus was about thirty-six hours previous to admission. He had vomited some greenish fluid on the same afternoon that he entered hospital. Pain was not a prominent feature, although there were occasional colicky attacks. There were no urinary symptoms.

CLINICAL EXAMINATION.—The patient, though thin, had a good colour and looked healthy. The tongue was dry and thickly coated, pulse 120, temperature and respiration-rate normal. The abdomen was slightly distended, and below and to the left of the umbilicus there was a large rounded firm mass which appeared to be rising out of the pelvis. This tumour was tender to pressure, could not be indented, and was quite immovable. The patient asserted that he had known of the presence of this lump for a year, but that it had caused him no inconvenience. Rectal examination, which caused pain, revealed a tumour in front, having a rounded margin, continuous with the abdominal swelling. The rectum was firmly compressed in its antero-posterior diameter, and the examining finger could not be passed above the free border of the tumour, nor could the mass be moved in any direction.

Three oil and turpentine enemata were given at intervals of one hour, but with no result, and the nurse reported that very little fluid could be run into the rectum. It was therefore decided that exploratory laparotomy should be performed.

OPERATION.—This was carried out under spinal anaesthesia combined with a preliminary injection of morphia and hyoscine. A left sub-umbilical paramedian incision was made, and on opening the peritoneum a firm, fleshy, reddish-blue mass was disclosed. At first the nature of this was not evident, but a hand passed up failed to find the spleen in its normal position, and a pedicle passing to the deep surface of the tumour was discovered. Some difficulty was experienced in delivering the spleen owing to the firmness of its impaction in the pelvis. When this was accomplished, a long pedicle, containing the tail of the pancreas, was revealed, and it was seen that it had undergone torsion through one complete turn. The gastrosplenic omentum

was intact, and the free edge of the great omentum was adherent to the viscus.

Removal of the spleen presented no difficulty. The pedicle was ligatured in several portions, distal to the tail of the pancreas, and it was found that the free ends of the vessels could then be invaginated by passing a purse-string suture through the peritoneum investing the pedicle. The abdomen was then closed without drainage.

PROGRESS.—There was no post-operative shock or vomiting, and the patient gave no anxiety for two days after the operation, during which time the bowels were evacuated. On the third day the patient vomited thrice each time about 16 oz. of light-brown material, and the pulse became rapid and thready. Examination of the abdomen at that time revealed distention and a succussion splash, and it became evident that he had an acute dilatation of the stomach. This yielded well to lavage and the prone position, and the pulse greatly improved.



FIG. 126.—Photograph of a 'wandering spleen' which became impacted in the pelvis and caused intestinal obstruction.

He remained, however, restless and talkative, and did not sleep well in spite of narcotics. On the eighth day he collapsed somewhat suddenly, the reason for which was obscure, as the abdomen was supple, the wound healed, and there was no evidence of any further gastric dilatation. He died on the morning of the ninth day. Unfortunately, permission for a post-mortem examination was refused.

PATHOLOGICAL REPORT.—I am indebted to Professor D. M. Grcig, of Edinburgh, for the following pathological report:—

“Macroscopical Appearances.—The spleen is misshapen. The hilum is not recognizable in any hollow, but seems to be on the convex border, and the vessels are obscured by fibrous thickening. The measurements of the spleen are: length 177 mm., breadth 101 mm., thickness 114 mm., transverse circumference 355 mm., longitudinal circumference 520 mm. This

spleen has two poles, one a narrow apex and the other a blunt base; to the latter is extensively attached a piece of great omentum measuring 127 mm. in length. The vascularity of this doubtless supplemented the normal blood-supply of the spleen, which must have been much interfered with. Besides the base and apex this spleen presents three borders and three surfaces. To two of the surfaces there have been extensive peritoneal adhesions, while the third surface has remained comparatively free. Two of the borders show notches. One near the apex measures 35 mm. by 10 mm., while two notches near the base of the spleen are more or less obliterated by adhesions and organized lymph. (*Fig. 126.*)

“*Microscopical Appearances.*—This spleen shows a high degree of passive congestion. Germinal areas are almost eliminated, and there is considerable fibrosis of endothelial cells, with much necrosis.”

Many authors have published cases of wandering spleen, but this is probably rather an indication of the rarity of the condition than otherwise. It may be noted, for instance, that up to September, 1920, only two spleens had been removed for this condition at the Mayo Clinic.¹ An exhaustive search of the literature has, however, failed to disclose a similar case to this in which the prolapsed organ produced intestinal obstruction by obliterating the lumen of the gut. Ledonski,² however, records a case in which a wandering spleen with a twisted pedicle produced an intestinal volvulus; while Finkelstein,³ who operated on 16 cases with a mortality of 25 per cent, states that peritonitis and intestinal obstruction resulting from torsion of the spleen are ‘frequent and very dangerous occurrences’. He does not, however, enter into any detail as to the mode of production of the obstruction, although he is probably referring to cases similar to that of Ledonski.

When the spleen becomes displaced it displays a pronounced tendency to drop into the pelvis, owing to the influence of gravity, and this accounts for many of the cases having been described by gynaecologists who have operated under an erroneous diagnosis of fibromyoma of the uterus or ovarian tumour. The majority of the authors are agreed that the condition is most commonly found in middle-aged multiparous women.

In the case under discussion, the twisting of the pedicle evidently acted as the predisposing cause of the obstruction, the consequent swelling of the organ sufficing to obliterate the lumen of the bowel. The onset of acute gastric dilatation is interesting in view of the fact that the operation was conducted under spinal anaesthesia. The cause in this case appeared to be air-swallowing, although traction on the gastrosplenic omentum may have had some influence in its production.

REFERENCES.

¹ MOYNIHAN, Sir BERKELEY. *Brit. Jour. Surg.*, 1921, viii, 307.

² LEDONSKI. *Khirurgia Mosk.*, 1908, xxiv, 559.

³ FINKELSTEIN, B. K.. *Brit. Jour. Surg.*, 1914, ii, 68.

HYDROCELE OF A FEMORAL HERNIAL SAC.

By HAMILTON BAILEY,

SURGEON TO THE DUDLEY ROAD HOSPITAL, BIRMINGHAM.

For fourteen years, L. M., age 58, had a right femoral hernia. About a year before she came under my observation she developed ascites due to cardiac failure, and the hernial sac became distended with ascitic fluid. After months of treatment with digitalis the general ascites completely abated, but the fluid in the femoral sac persisted. One week before admission to hospital



FIG. 127.

the swelling had been tapped. The distended femoral sac, as seen in the illustration (*Fig. 127*), is surmounted by a scab which formed around the site of this puncture, and the contents had become slightly infected. Three days later the sac, which by this time had become frankly purulent, was incised. After discharging for a fortnight, the wound healed, and the patient left hospital with no sign of the femoral hydrocele.

REVIEWS AND NOTICES OF BOOKS.

Scoliosis: Rotary Lateral Curvature of the Spine. By SAMUEL KLEINBERG, M.D., F.A.C.S. Medium 8vo. Pp. 311 + xvi, with 140 illustrations. 1926. New York: Paul B. Hoeber Inc. London: Humphrey Milford. 30s. net.

WE may take it that this book embodies the practice followed at the New York Hospital for the Ruptured and Crippled, the work having been done in the clinic of Dr. Royal Whitman, to whom the author acknowledges his indebtedness in the preface. Looking at the book as a whole, we are impressed by the value of the letterpress and the care with which it has been written. It is evidently the result of much careful thought and painstaking work, and is not a mere collection of pictures held together by indifferent description.

Every aspect of the subject is dealt with, including treatment by operation. In describing the movements of the normal spine the author follows Lovett in dividing these into three only, viz., flexion, extension, and lateral flexion plus rotation. We cannot approve, however, his description of functional scoliosis, since he states on p. 38 that on bending forwards "one side of the back is higher than the other"—a statement which is inaccurate and misleading. It is generally admitted that on flexion a postural curve disappears, and there is no evidence of rotation towards the convex side. He makes no mention of the fact that the rotation, if present, in the lumbar region in such a case is on the *concave* side of the curve, is only due to inequality in the length of the legs, and is apparent and not real. Again, he states that when the child is asked to straighten up he can do so readily. In many cases this is certainly not true until after special instruction.

The vexed question of the importance of anatomical abnormalities at the lumbosacral junction as causes of scoliosis is well discussed, and the author, we think rightly, concludes that, though such abnormalities may "in a very small number" of cases account for the scoliosis, in most they are secondary to antecedent curvature of the spine. As usual, the reproduction of the radiograms is far inferior to that of the rest of the illustrations, and some are quite useless. It is pleasing to find the author insisting that symmetrical variations in number of the vertebræ have no influence on the causation of scoliosis. In the author's experience, scoliosis due to asymmetrical congenital abnormalities rarely passes beyond the mild and moderate in degree. We wish we could agree with him in thinking that paralytic scoliosis, if it cannot be corrected, "can surely be prevented from making progress." Tuberculosis is only mentioned with such relatively rare affections as osteomalacia, syphilis, spondylitis deformans, etc., and is dismissed in a line. No mention is made of the frequency with which lumbar caries produces a lateral as well as an anteroposterior curve.

In discussing the many theories as to the causation of the so-called static cases, which he apparently distributes into two groups—occupational and 'without evident causes'—he refers at length to Buchanan's work at the Hospital for the Ruptured and Crippled on affections of the vertebral epiphyseal plates as a possible cause: he makes no mention of Bankart's paper and the latter's application of Sherrington's work on postural tone to this subject. We agree with the author's outspoken condemnation of the value of the ingenious and complicated instruments for measuring the degree of deformity. He rightly says that when the improvement is so slight as to need mathematically accurate measurement to demonstrate it, it is not worth the effort expended to ascertain it. Again, we welcome his advice to err on the side of keeping a poliomyelitic child too long in the recumbent position rather

than allow him to sit up too soon. Hysteria is only mentioned as a possible cause, and nothing whatever is said as to the diagnosis of this extremely important, if rare, group of cases.

The chapters dealing with treatment are naturally the most important, and are, in fact, the most interesting. The author evidently believes in the possibility of at any rate improving the cases of structural scoliosis, and advocates vigorous methods of dealing with them. In all but the mildest cases he advocates forcible correction of the deformity, followed by the use of a brace or corset and gymnastic exercises. The chapter on the last is good, and states very clearly the object aimed at by exercises and the limitations of their use. We are glad to see the author insists on the necessity of the patient "constantly and consciously holding his body in the corrected attitude". He evidently has little use for steel braces of any sort. On the vexed question of the value of passive stretching he decides that the method helps to reduce the deviation of the spine but has no effect on the rotation. The various methods of forcible correction are fully discussed. The Abbott flexion method, after a fair trial with the usual plaster jacket and with a steel brace designed by himself, he condemns as painful and distressing, and because it yields results no better than, if as good as, those achieved by other methods. The extension methods, with lateral traction, for the application of plaster jackets, the author uses extensively. Full details with illustrations of the way in which the author applies the jacket are given. With either method he claims improvement in 55 to 60 per cent of cases.

He is evidently enthusiastic on the results of the operative method of treatment, which, as used at the particular hospital at which he works, "bids fair to replace other methods of treatment in a large but selected group of cases". The method advocated involves a stay of from three to four months in hospital. To begin with, the patient is placed on a convex frame for four to eight weeks, with traction on the head and pelvis. The operation includes portions of the Hibbs, Albee, and Forbes techniques. A long beef-bone graft is used in preference to one taken from the patient's tibia. Ten or twelve vertebræ are fused. After a week in bed the patient is again placed on the convex frame and traction reapplied. After two months a light plaster jacket is worn for six months, and then a corset, which is gradually discarded. As to results, in 31 out of 33 cases the improvement obtained by the preliminary traction has been maintained, and the author believes fixation and prevention of increase of the deformity has been achieved. Two cases relapsed. One patient died as a result of operation. The indication for operation is a progressive increase of the deformity, irrespective of the etiology of the scoliosis or the age of the patient. The way in which this subject is dealt with must prove of great use to the surgeon called upon to treat these cases. So impressed is the author with the improvement achieved by traction on a concave frame that he is disposed to use this method instead of plaster jackets in cases not requiring operation.

This book can be recommended to all seeking information on the subject. It should be read by every orthopædic surgeon.

The Inflammatory and Toxic Diseases of Bone: A Text-book for Senior Students. By R. LAW FORD KNAGGS, M.C. (Cantab.), F.R.C.S., Consulting Surgeon to Leeds General Infirmary, formerly Professor of Surgery in the University of Leeds. Demy 8vo. Pp. 416 + xii, illustrated by numerous photomicrographs by G. H. RODMAN, M.D., Hon. F.R.P.S. 1926. Bristol: John Wright & Sons Ltd. 20s. net.

IN his preface the author questions whether the title of this work accurately defines its scope. It is doubtful whether all the diseases of bone included within this volume are inflammatory or toxic; but there are also included descriptions of diseases in which the bone lesion forms by no means the chief part, of which the chapters on arthritis deformans and Charcot's joints are the most obvious examples. This remark is not intended to suggest any discontent with the author's selection, which is in most respects an advantage, because the author writes on what interests him and endeavours to correlate the different bone diseases with one another; in

fact the chief debt which teachers of surgery and students reading for the higher examinations will owe to him is the light he sheds upon the inter-relationship of osteitis deformans, osteitis fibrosa, and osteomalacia.

One began to read this book for the purpose of review, but soon found it so interesting and so sound a corrective to inaccurate or loose ideas on the pathology of the diseases of bone, that it has already served as a great help in the teaching of students. When one thinks of what had to serve in one's own student days as a description of that extremely important and common disease, acute osteomyelitis, and compares it with Mr. Knaggs' chapter, which no student could fail to understand, one is most envious of the surgical beginner who can gain his knowledge of this subject by the aid of so fascinating a mirror.

The illustrations are delightful; one reproduction after Howship of leontiasis ossa is perhaps the most beautiful thing to be discovered in any work of surgery.

To have produced this volume in the course of one's ordinary professional career would have been no mean achievement, but to have compiled so complete a pathological description of what most people regard as a relatively dry and uninteresting section of surgical literature after one has put aside ordinary professional duties is indeed a test of a very high endeavour and most conscientious sense of duty.

Clinical Surgical Diagnosis. By F. DE QUERVAIN, Professor of Surgery and Director of the Surgical Clinic at the University of Berne. Translated by J. SNOWMAN, M.D. Fourth English edition. Medium 8vo. Pp. 937 + vi, with 750 illustrations and 7 plates. 1926. London: John Bale, Sons and Danielsson Ltd. 42s. net.

THIS new edition of de Quervain's *Clinical Surgical Diagnosis*, the last edition of which appeared in 1921, is a translation of the eighth German edition which was published in 1922, with the addition of a large amount of new material to be incorporated in a new edition shortly to be brought out in Germany. The principal alterations are in the chapters on the brain and the modern methods in diagnosis of renal function, while the chapter on the thyroid gland has been completely rewritten.

In dealing with his subject the author considers each part of the body in turn, and discusses the means of differentiating between the various pathological conditions which are to be met there. It is done in a very practical way: the most prominent symptom is taken as a starting-point and its probable cause considered, most attention being devoted to the more common diseases, whilst the rarer ones are treated in the proper perspective. The book is well written and easily readable. A conversational style is adopted as if a verbatim report of a series of clinical lectures had been recorded, and the stilted literary style which is so common among medical authors is avoided.

The only criticism we have to offer is when the author leaves his subject of diagnosis for that of pathology or treatment, but this is an infrequent happening. For example, on p. 140, when discussing sarcoma of the tonsil, we have: "Most of these sarcomata are of the lymphosarcomatous type and are not genuine tumours, even if they cause glandular metastases. Treatment by arsenic or X rays often causes them and their metastases to vanish, without leaving a trace." This may be the experience abroad, but it is certainly not the teaching or finding in this country. Again, the treatment of the peritonitis complicating acute appendicitis is discussed, and we have: "It must be washed out and thoroughly drained", a statement with the first part of which most of us strongly disagree.

The only noteworthy omission is that no reference is made to cholecystography after filling the gall-bladder with an opaque salt, a diagnostic method which has been sufficiently long in use, and is sufficiently useful, to warrant its inclusion in a book of this type. These are only minor points, and do little to detract from the value of the book as a whole.

The illustrations are particularly good: they are numerous and well produced, and it is almost possible to see a picture of every condition mentioned in the text, or at least of the ones more commonly met with. For a book of reference on the purely diagnostic side of surgery it still maintains its high position, and we can confidently recommend it to our readers.

Manual of Operative Surgery. By Sir HOLBURN J. WARING, M.S., F.R.C.S., Surgeon to and Joint Lecturer in Surgery at St. Bartholomew's Hospital, etc. Sixth edition. Crown 8vo. Pp. 868, with 618 illustrations. 1927. London: Humphrey Milford. 18s. net.

THIS well-known and widely-used manual hardly requires any detailed review. It first appeared in 1898, and from that date onward has maintained its character for clearness and simplicity. Like all small books it runs the risk of having its original character of brevity lost by constant additions which appear in each fresh edition. The present edition has been revised throughout and contains some very good additional illustrations by Maxwell. Probably still further improvement could be effected by the omission of operations rarely, if ever, performed, e.g., that for the suture of a badly lacerated spleen. The chapters on bones and joints have not undergone much change in the last ten years, and they represent the operative surgery class of work rather than a clinical presentation. All the figures of the suture of a ruptured patella show the sutures badly placed, with sharp angles and kinks. Formal excisions are described as the examinee requires to know them, but the modern operations of arthroplasty are not mentioned. We venture to suggest to the author that he ought to decide whether the book is primarily intended for the Final Fellowship examination or for the practising surgeon. At present it is too much for the former and not enough for the latter.

Thérapeutique chirurgicale. By P. LECÈNE, Professeur à la Faculté de Médecine de Paris, and R. LERICHE, Professeur à la Faculté de Médecine de Strasbourg. Vol. I (pp. 644), General Principles, Limbs; Vol. II (pp. 508), Head, Neck, Thorax, Spine, Pelvis, Nose, Ear, and Throat. 1926. Paris: Masson & Cie. 10s. each volume.

VOLUME III, written by Lecène on the abdomen and genito-urinary organs, has already appeared. The three volumes complete a work for which the authors deserve the highest praise. Concentrating upon the subject of surgery as a therapeutic agent, it appears to us to be a publication of an original character. In each section the indications for surgical treatment are first dealt with. The various feasible surgical procedures are then described; and the results, immediate and remote, which may be expected of them are based both on the experience of the authors and on the statistics of other well-known surgeons. If the subject is one in which the author is specially interested, a most valuable résumé of his own choice of treatment for picked cases is appended. Every chapter is followed by a bibliography giving the more important references to the literature.

Since the work refers to surgical treatment, the problems of diagnosis are not referred to, except, as for example in dealing with certain breast tumours, when the first step in treatment may be establishing the nature of the tumour by operation. For the same reason pathology is not dealt with except in so far as a brief description of its pathology is necessary to indicate the particular condition under consideration. No instruction in pathology is given, but the familiarity with surgical pathology necessary for the proper understanding of the indications for treatment is assumed. The outlines, and not the details, of operative technique are described.

It will thus be seen that the scope of the work is narrowed down purely to the problems of the management of surgical cases; and if it be possible to write a book as a guide to 'surgical judgement' this must surely be one of the most worthy attempts ever made to accomplish so difficult a task. There are selected references to the best of all the European and American literature, and these in themselves, even apart from the carefully reasoned criticism of the authors, make the volumes worth reading. One feels that throughout the work everything has been carefully thought out in the light of ripe experience, and there is no suspicion of handing on advice with antiquity as its only justification. The familiarity of the authors with recent advances all over the world is as amazing as it is stimulating. The effects of the war are frequently to be noted.

In a work which is uniformly of such a high standard it is difficult to pick out the specially valuable sections; but those by Leriche on the general principles of

the treatment of wounds and on the blood-vessels, and Lecène's chapters on the skull and brain and on wounds and infections of the chest, are perhaps the most noteworthy. The part of Vol. II dealing with the ear, nose, and throat has been written by Professor F. Lemaître.

The authors explain that certain special subjects such as ophthalmic surgery and the orthopædic problems in children are not dealt with; but the principles laid down in these books deserve the careful consideration of all general surgeons—and physicians, for these volumes show repeatedly how modern advances are introducing fresh surgical procedures which may in time prove of value in diseases which up to the present have been considered 'medical', and in which surgery as a therapeutic agent has not been employed.

Cystoscopy. By JAS. P. MACALPINE, F.R.C.S., Honorary Surgeon and Surgeon in Charge of the Genito-urinary Department, Salford Royal Hospital, Manchester. Large 8vo. Pp. 284 + xvi, with 181 illustrations and 12 coloured plates. 1927. Bristol: John Wright & Sons Ltd., 25s. net.

THE author states in his preface that, in the belief that there was a real need for a book on this subject, he has 'attempted the task'; after reading the volume very carefully and with intense pleasure, we venture to assure the author that his attempt has been extraordinarily successful, and that this book is a remarkable achievement; we consider it to be one of the best monographs we have ever read, and we predict that it will rapidly become the standard work on the subject.

We are extremely grateful to both author and publishers for the convenient form in which the work has been printed; at last one can study a book on cystoscopy without having to sit up to a table; it is beautifully printed, and there is hardly a printer's error in the whole work of 284 pages; the author's style is pleasant and easy to follow, and he has taken the utmost pains to make his meaning clear.

With a quite unnecessary modesty, the author apologizes for the limited number of cystoscopic drawings from which he had to choose; the twelve plates of coloured cystoscopic pictures are delightful, are beautifully reproduced, and have in no way suffered from their being presented on a smaller page than is usual in a cystoscopic atlas. There are also 181 other illustrations; of these, we can say that they are charmingly drawn, are entirely relevant to the text, and help materially in elucidating it.

The book is not merely a manual of cystoscopic technique, but contains a vast amount of clinical and pathological material: especially good are the sections on tumours of the bladder, on tuberculosis of the urinary tract, on ureteric catheterization, and on the diagnosis and treatment of stone in the ureter; a former article on symptomless hæmaturia is also included, and is well worth careful reading. One of the charms of the book is that, whilst Mr. Macalpine acknowledges the work of other urologists, one feels that he is relying so largely on his own experience.

Perhaps the two most striking chapters are those on the cystoscope and on the examination of a urological patient: we have read many accounts of the mechanism of the cystoscope, and have sometimes wondered whether the difficulties of understanding the somewhat complicated optical system of this instrument were not due to the fact that the writer himself was not altogether clear on the subject; no one could possibly think this of the present writer: the whole chapter is a model of lucid exposition, and we defy any person of average intelligence to read this section and not have a very reasonable idea of the mechanism of the cystoscope.

The sections on the care and sterilization of the cystoscope are full of valuable advice, and that on the tracing of faults in the electrical transmission should be studied by every surgeon who uses this instrument.

The following chapter, on the examination of a urological patient, contains a remarkably good account of how to use this instrument: the author is evidently a urologist of decided views, but he always gives ample reasons for the belief that is in him: we note that, after a prolonged trial of local anæsthesia, he has become an adherent of the sacral method, and we remark with sympathy his opinion that

"the best of all anæsthetics is a gentle and educated touch, and no other kind will make up for a lack of this". We agree with him that the pain felt by the male during cystoscopy is due very largely to the straightening out of the more or less fixed curves of the proximal urethra, and that local anæsthesia does little to ameliorate this. He points out that the normal mucous membrane of the bladder is insensitive, and that painful sensations there depend on the presence of inflammation, and further, that the degree of pain is due much more to the depth to which the inflammation has progressed than to its superficial extent, as is well shown in tuberculous infection of that organ.

In this, as in all the other chapters, theory and practice are most skilfully interwoven, with the inevitable consequence that the reader is convinced that the author's methods of diagnosis and treatment are sound; his occasional references to the anatomy and physiology of the urinary tract add greatly to the enjoyment of the book.

After this pæan of praise, we hope the author will not take it amiss if we point out that there are some, though only a few, shortcomings in the volume; thus on page 156 the word 'faceted' would look more at home with another *t*, and on page 105 the word 'serpigenous' should surely be *serpiginous*: again, on page 76, the name 'trigonitis pseudo-membranosum' gives a shock to the most amateur of classical scholars; we have looked up Pilcher's *Practical Cystoscopy* (2nd edition, 1915, p. 222), and there we find a condition of the bladder described as 'œdema trigoni membranosum'; can this be the same?

It is only our personal opinion, but we think that, in future editions, the section on malakoplakia might well be omitted; the information given on this rare condition is nearly all within inverted commas, and one would so much prefer to have the author's personal experience on some subject with which he is well acquainted. If one might make a suggestion for the future, the question of vesical fistulæ would well deserve a separate chapter; also the writer's experience of the after-effects of implanting the divided ureter into the bladder; it has been stated lately by some French urologists that the corresponding kidney after such an operation becomes eventually functionless; Mr. Macalpine must have seen many such cases, and his observations would be highly interesting and valuable; moreover, the question is entirely relevant to such a book, as it can be settled only by skilled cystoscopy.

There is a good index, but no bibliography; there are a few references in the text, but we think future editions would benefit by a short chapter devoted to a discussion of those works on urology of which the author has proved the value; the usual list of works appended at the end of a book is of little value, as there is no discrimination as to their relative merits, and the average surgeon has not the time or the inclination to look them up.

In conclusion, we congratulate Mr. Macalpine on this book; we think he is *facile princeps* in the art of writing about cystoscopy, and, if it is true that easy writing makes very hard reading, we fancy that he must be one of those with an infinite capacity for taking pains.

Le Cancer de l'Œsophage. By L. BÉRARD, Professeur à la Faculté de Médecine de Lyon, and A. SARGNON. Medium 8vo. Pp. 450, with 76 illustrations. 1927. Paris: Gaston Doin & Cie. 77 fr.

THIS volume is one of a series which includes monographs on cancer of the intestine, kidney, rectum, thyroid, uterus, eye, and upper air-passages. It is a monument of industry, a most extensive search having been made in the world's literature for the information the book contains. It may be said to summarize almost everything that is known with regard to cancer of the œsophagus. Its faults are that it is very long, it is inclined to be rambling in many parts, and it does not point the way clearly to any definite conclusions. The length is due to unnecessary repetition, and reference to subjects other than cancer. It is indefinite in that the opinions or results of many observers are recorded, and the reader is often left to form his own conclusions from this rather confusing mass of statistics.

The book starts with a valuable anatomical section which contains a well-illustrated account of the problem of surgical approach in operations on the œsophagus. The chapters on etiology and pathology with their bibliography make it a useful book of reference to anyone working on this subject. The sections on diagnosis and treatment contain accounts of all the useful modern methods, but do not exclude those that are obsolete, and thus make tedious reading. They do not contain any 'original' matter, and they offer no hope of a better outlook as regards the curative value of operative treatment.

The book is illustrated by numerous drawings which on the whole are reasonably clear.

Baillière's Synthetic Anatomy: A series of Drawings on Transparent Sheets for facilitating the Reconstruction of Mental Pictures of the Human Body. By J. E. CHEESMAN, Deputy Medical Officer of Health for Leyton, London. Size of Plates $7\frac{1}{2}$ in. \times 9 in. Part I. The Upper Arm and Shoulder; Part II. The Forearm; Part III. The Hand. To be completed in 12 Parts. 1926. London: Baillière, Tindall & Cox. 2s. 6d. each net.

It is undoubtedly true that the average student of anatomy, when apart from actual dissection, often finds a real difficulty in forming a mental picture of the body structure in relationship to planes. Dr. J. E. Cheesman, in his *Synthetic Anatomy*, has produced what at the present time is perhaps the best and most convenient substitute for the actual body. The idea is not entirely original, but we must congratulate the author on his novel conception of superimposing one plane of tissue drawings upon the other on transparent sheets. The picture thus presented permits the student to carry his eye from one body plane to another without having to disturb his chain of thought by removing one layer from a model to expose the next, or by folding back the leaves of a book.

Three parts of the twelve which constitute the atlas have been published. These deal with the upper extremity. Each part consists of some twelve coloured representations, and each of these is carefully calculated to suit the progress of the reader's thoughts. In anatomical details the work is extremely accurate. Drawings and colourings are not lacking in artistic finish. We feel certain that this work will form a great asset to students in their study of anatomy, and to all for purposes of rapid revision. Each of the twelve parts may be purchased separately at the reasonable price of half a crown. We congratulate the author on the novelty of his conception and have every confidence in recommending his production.

Anatomie élémentaire des Centres nerveux et du Sympathique chez l'Homme: Vie de Relation et Vie végétative. By P. GILIS, Professeur d'Anatomie à la Faculté de Médecine de Montpellier. Crown 8vo. Pp. 232, with 35 illustrations. 1927. Paris: Masson et Cie. 20 fr.

This little book, written by a professor of anatomy, is intended to give students a comprehensive survey of the anatomy of the central nervous system, and also of the sympathetic nervous system. It is intended also to bring out that these are not two separate systems but one system, forming one unit, each part of which reacts constantly on the other. The author holds that it is necessary to teach students this truth now that the disorders of the central and of the sympathetic nervous system play such an important part in medicine and surgery. It is a useful little book, written on sound educative lines.

Hernia and Hernioplasty. By ERNEST M. COWELL, D.S.O., M.D., F.R.C.S., Surgeon, Croydon General Hospital; Hunterian Professor R.C.S. Demy 8vo. Pp. 128 + xvi, with 64 illustrations and 8 plates. 1927. London: H. K. Lewis & Co. Ltd. 9s. net.

THERE is no finality in medicine or surgery. There is more to be said even on the subject of hernia and its radical cure. The older surgeons of to-day have been inclined to think that the operation for the cure of inguinal hernia is of the 'scaled pattern' variety. Good as this operation has proved to be, it still fails in a small

percentage of cases, and this little book shows how this small number may be still further reduced by employing some of the plastic methods recently introduced.

It is a really useful book and well repays perusal. If a friendly criticism is allowed, and the book goes to a second edition, we would urge that the illustrations be improved. The photographs are not sufficiently clear, and semi-diagrammatic drawings would be more useful. Then there is a curious little mistake the author makes in stating that "the fold of the groin indicates the position of Poupart's ligament". With the exception of these minor points we can strongly recommend the book.

Diagnostische und therapeutische Irrtümer und deren Verhütung. Edited by Professor SCHWALBE. Eighth part: Peritonæum (KLEINSCHMIDT), Appendicitis (PAYR), External Hernia (HOHLBAUM). Pp. 261, with 36 illustrations. 1926. Leipzig: Georg Thieme. M. 16.50.

This is a part of a large System dealing with diagnosis and treatment. It is a very careful and complete discussion of the mistakes that are liable to be made, relating both to the main diseases under consideration and also all the possible complications. The treatment of each disease and complication is also dealt with very fully, special attention being paid to the things which may go wrong at every turn.

There is perhaps a little overlapping in the first two sections of the book, because the first deals with peritonitis including appendicitis, and the second is concerned only with appendicitis in its various forms and with all possible complications. This section (132 pages) by Professor Payr, of Leipzig, represents the bulk and the most important part of the book, and constitutes a most valuable monograph on the subject. The chief drawback to these articles is perhaps the absence of any tabulation, so that any particular point on which it is desired to seek information has to be searched for rather closely; but this drawback is minimized by an excellent index. The illustrations are scanty, and this fact also makes the reading of the text more tedious; but as a thorough discussion of the difficulties in diagnosis and treatment of peritonitis, appendicitis, and external hernia, it forms a most valuable work of reference.

Les Pancréatites aiguës chirurgicales. By PIERRE BROCCQ, Chirurgien des Hôpitaux. Pp. 188, with illustrations. 1926. Paris: Masson et Cie. 4s. 2d. net.

It is always instructive to reconsider a series of observations made over a period of years and to rearrange facts in their proper perspective. The author has previously made twelve contributions to the literature on the subject of acute pancreatitis, and in his latest book reviews his published cases, together with twenty new ones. The book is based on a study of 340 cases of the various types of acute pancreatitis, together with a large number of cases of the disease produced experimentally in dogs. He is, therefore, well qualified to discuss the subject and to draw conclusions as to the clinical and pathological course of the disease.

On the clinical side the picture of the disease is clearly drawn, and its progress from the early vague attacks of abdominal pain to the acute attack, its operative treatment and sequelæ, are laid down in detail. The only criticism which we would offer is that he is a little too insistent that a cholecystotomy should not be performed when operating for the acute disease.

On the pathological side the picture drawn is logical and convincing. It is maintained that tryptic digestion and not infection is the starting-point, and that if the latter occurs it is secondary and accidental. He says that the activation of the trypsinogen is usually due to something gaining access to the pancreas along the duct of Wirsung, and, if he is perhaps a little too prejudiced as to this explanation, he brings much evidence, both clinical and experimental, to support his views.

This book fulfils a very useful purpose in putting clearly the present position of acute pancreatitis in all its aspects. The text is good, the illustrations are well reproduced, and we can confidently recommend it to those who are interested in the subject.

Practical Methods in the Diagnosis and Treatment of Venereal Diseases. By DAVID LEES, D.S.O., M.A., M.B., F.R.C.S. (Ed.), Surgeon in Charge of Venereal Diseases, Royal Infirmary, Edinburgh. With an Introduction by WM. ROBERTSON, M.D., F.R.C.P., D.P.H., M.O.H. Edinburgh. Crown 8vo. Pp. 605 + xvi, illustrated. 1927. Edinburgh: E. & S. Livingstone. 15s. net.

If a popular novelist could be induced to rewrite this book it might become a 'best seller' in the medical world. Unfortunately the literary standard falls short of the clinical, and the numerous split infinitives and pleonasmis, coupled with the inordinately frequent use of such words as 'carefully', 'exhibition', 'exhibited', tend to jar on the reader.

The section dealing with syphilis is extremely good and the illustrations are excellent; differential diagnosis, which is so important, is well done. That on gonorrhœa is hardly so good, but the teaching is eminently sound.

Vaccines are accorded the importance they deserve, but diathermy is dismissed in two lines, and hexyl-resorcinol is not even mentioned. Such expressions as 'normal' (for physiological) saline, 'male gonorrhœa', 'the venereal patient', and 'alternately' (for alternatively) should not occur. The general impression conveyed is that the materials have been carefully and laboriously collected and then written up hurriedly and without due thought. A second and improved edition may be predicted in the near future.

Guy's Hospital Reports. Edited by ARTHUR F. HURST, M.D. Vol. LXXVII (Vol. VII, Fourth Series), No. 1, January, 1927. Medium 8vo. Pp. 126, illustrated. 1927. London: *Lancet* Ltd. Annual subscription, £2 2s. net; or 12s. 6d. net per issue.

THIS volume does not contain much of interest to surgeons, beyond an article by W. H. Ogilvie on "Two Cases of Epitheliomata Occurring Simultaneously in Different Parts of the Body". These occurrences are rare, but are always interesting and justify publication.

LISTERIANA

1. **Reminiscences of Lister, and of his Work in the Wards of the Glasgow Royal Infirmary.** By Sir HECTOR CLARE CAMERON, C.B.E., LL.D., M.D., etc., Consulting Surgeon, Glasgow Royal Infirmary. Medium 8vo. Pp. 45, with 3 plates. 1927. Glasgow: Jackson, Wylie & Co. 2s.
2. **Lister as I Knew Him.** By J. R. LEESON, M.D., C.M. Ed., F.L.S., F.R.A.S., Senior Consulting Physician, St. John's Hospital, Twickenham. Demy 8vo. Pp. 212 + xi, with 2 plates. 1927. London: Baillière, Tindall & Cox. 8s. 6d. net.
3. **Lister and the Lister Ward in the Royal Infirmary of Glasgow.** Royal 8vo. Pp. 132 + xvi. with several plates. 1927. Glasgow: Jackson, Wylie & Co. 12s. 6d. net.

THESE three volumes are the direct outcome of the Lister Centenary. Two of them can be read with pleasure: the third only with shame not unmingled with righteous anger.

Sir Hector Cameron and Dr. Leeson are both hero worshippers. Their reminiscences of Lister whilst he taught and worked at Glasgow are full of interest, and form a fitting supplement to Sir Rickman Godlee's *Lord Lister*. They tell of him as a man with like parts as ourselves, but saved by his Quaker ancestry from similar passions. Both speak of the personal affection he inspired; of his minute attention to detail; of the unswerving pursuit of his ideal; of his professional isolation; of his entire absence of self-seeking; of his generous nature; of his kindness of heart; and of his happy, though childless, home life. Working with him and under him they seem to have been ignorant of his true greatness or of the revolution which he was effecting in the practice of surgery. They recognized that to him each patient was a poor man or a poor woman whose feelings were to be respected and whose wounds were to be healed more quickly and more safely than those of his

colleagues. They saw a constant succession of surgeons from foreign countries who followed his practice, but of the great underlying principles which he was slowly formulating they remained in ignorance. Dr. Leeson's book is especially valuable because he went straight from the newly-built St. Thomas's Hospital in London, where Miss Nightingale had already introduced the modern nursing system, to the Royal Infirmary at Glasgow, which maintained the old tradition of ancient wards and inferior nursing. In London he left hospitalism in spite of the palatial housing; in Glasgow he found healing by first intention in the most inferior surroundings. How this occurred Dr. Leeson explains most clearly.

Lister and the Lister Ward is a record of the most astounding piece of wanton vandalism which has occurred for many years past. It is of a piece with the destruction of the manuscripts of John Hunter by Sir Everard Home. The Royal Infirmary of Glasgow has recently been reconstructed, and the opportunity occurred of keeping the male accident ward in which Lister did his monumental work. The Managers at first intended to preserve it, but evil counsels afterwards prevailed; the vote was rescinded, and, in spite of remonstrances received from many parts of the world, the ward was pulled down and the site is now derelict. The Wellcome Historical Medical Museum, thanks to the energy of Mr. C. J. S. Thompson, then the Curator, secured a part of the ward and some of its furniture. These have been put together, and it is possible to get an idea of what the ward looked like; but the genius loci is wanting, and what should have been preserved for ever has now been permanently destroyed.

This volume records, so far as can be done in words, plans, and illustrations, the history and appearance of the Infirmary buildings. It is thus a fitting supplement to Sir Hector Cameron's *Reminiscences* and to Dr. Leeson's account not only of Lister as a man but of the conditions under which he worked first in Scotland and afterwards in England. The three books ought to be read by every operating surgeon, for they will teach him how great an advance has been made by a single generation.

Lister's Centenary Exhibition at the Wellcome Historical Medical Museum: Handbook. Pp. 216, illustrated. 1927. London: The Wellcome Foundation Ltd.

The Wellcome Historical Medical Museum: Handbook indicating the chief Features and Objects Exhibited in the Museum. By HENRY S. WELLCOME, Director, and L. W. G. MALCOLM, M.Sc. (Cantab.), F.R.S.E., Conservator. Pp. 118, illustrated. 1927. London: The Wellcome Foundation Ltd.

MEMBERS of the medical profession throughout the world who are interested in the history of their calling owe a debt of gratitude to Mr. Henry S. Wellcome for the magnificent museum he has gathered together in London with the help first of Mr. C. J. S. Thompson, more recently of Mr. L. W. G. Malcolm. The Lister Centenary Exhibition owes much to both these Conservators. The energy and foresight of Mr. Thompson secured a part of the Lister Surgical Ward and of its furniture when the Directors of the Royal Infirmary at Glasgow pulled it down. The organizing power of Mr. Malcolm has led to a rare display of Lister relics which are catalogued in the two volumes just issued by the Wellcome Foundation Limited. Sir Hector Cameron introduces them with a lively account of the evolution of Lister's system of antiseptic surgery. He tells his story with the advantage of first-hand knowledge. He served for two periods as Lister's house surgeon, was Professor of Clinical Surgery in the University of Glasgow, and remained a friend of the Master throughout his life. Sir Hector's introduction is followed by a Life of Lord Lister, and a very useful list of his house surgeons and dressers in Glasgow, Edinburgh, and London. Both books are remarkably well illustrated.

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EPOCH-MAKING BOOKS IN BRITISH SURGERY.

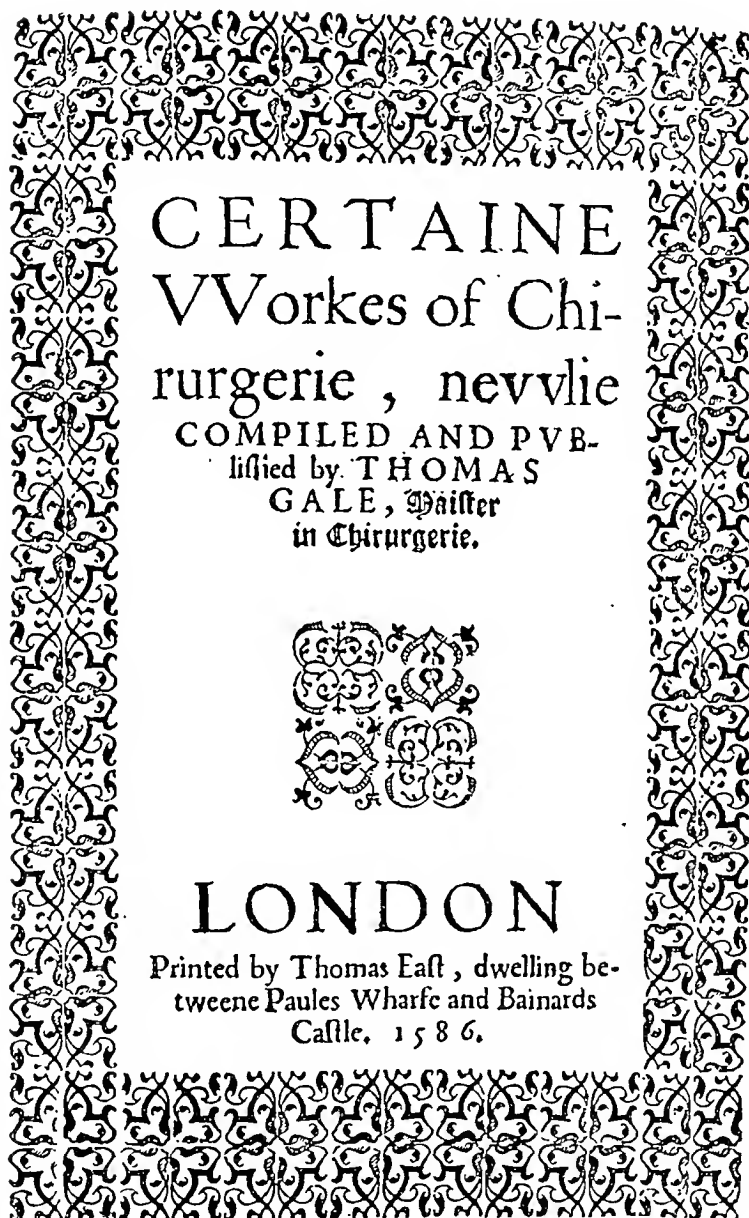
By SIR D'ARCY POWER, K.B.E., LONDON.

II. CERTAIN WORKS OF CHIRURGERIE BY THOMAS GALE, MAISTER IN CHIRURGERIE.

THE fifteenth century in England was so distracted by wars and rumours of wars that the works of John Arderne, Gui de Chauliac, and John of Vigo had to suffice for the instruction of surgeons. Who could sit down in London to write a text-book when the watch of ten thousand men, often with the Mayor himself at the head, was parading the streets nightly to ensure the peace of the City? Surgeons did not begin to write about their art until the sixteenth century was well advanced, and then, as if they were taking stock of surgical knowledge, they went back to the old manuscript sources, and there came into existence such a book as Vicary's *Englishman's Treasure*. Nearly twenty years later—that is to say, in 1563—Thomas Gale published his *Surgery* in three parts: first *The Institution of a Surgeon*, then his *Enchiridion* or Manual of Surgery, and finally his *Treatise on Gunshot* and *The Office of a Surgeon*.

Of these, *The Institution of a Surgeon* is the most interesting. It is thrown into the form of a catechism, a method which had been used in teaching midwives as far back as Mosehion, who lived about the year 580 A.D. The speakers are John Yates, who was an examiner in the Barber-Surgeons' Company in 1570; Maister Thomas Gale himself, who had been Master of the Company in 1561; and John Field, Master of the Company in 1577, who had been the servant and friend of Richard Ferris, a surgeon held in the highest respect by his fellows, but of whom little is now known, for he does not appear to have written anything. Yates, Gale, and Field were all well-known surgeons, therefore, Gale being the eldest.

John Yates begins the dialogue in the true spirit of Elizabethan times: "Phœbus who chaseth away the dark and uncomfortable night easting his golden beams on my face would not suffer me to take any longer sleep but said: Awake for shame and behold the handiwork of our sister Flora, how she hath revested the earth with most beautiful colours, marvellously set in trees, plants, herbs and flowers; insomuch that the old and withered coat



The title page of the 1586 edition, reproduced from a copy in the writer's possession.

of Winter is quite done away and put out of remembrance; at which words of Phoebus my heart quickened in me, and all desire of sleep was eft soon forgotten. Wherefore I am now come into this beautiful meadow to recreate myself and gather some of those pleasant herbs and flowers which here do grow. But let me see, methinks I see two men walking together and reasoning also very earnestly. I will approach nearer unto them, perchance they be of my acquaintance; surely I should know them. I am deceived if the one be not my friend M. Gale and the other Maister Field. It is so indeed, wherefore I will go and salute them. God that hath brought us together into this place make this day prosperous and fortunate unto you both.

"THO. GALE: Brother Yates, the same we wish unto you and you are welcome into our companie.

"JOHN FIELD: This fair and pleasant morning will not suffer Maister Yates to keep his bed, but leaving the city he roameth the fields to espy out some strange herbs unto him yet unknown.

"JOHN YATES: I must of force confess that you do hit the nail on the head, but since my hap is so fortunate as to meet with you both and that now in this pleasant morning I would leave off my former determined purpose and require you to enter into some talk of surgery.

"THO. GALE: Your request is honest and reasonable and therefore not to be denied.

"JOHN FIELD: We were about the like thing whenas you saluted us, wherefore renewing our first talk we will accomplish your desire."

The trio then discuss the writers on surgery, the etymology of the word, and the low state into which surgery had fallen. They agree that the operation of trephining is satisfactory, and Gale says: "In my judgement the trepan is most necessary and of an excellent invention in hurts of the head. For without it where the cranium is fractured, bruised or depressed you shall little prevail". He quotes a case in illustration when "Anno 1559 in Cambridgeshire a servant of one Mr. Wroth riding in the fields and leading a young horse in a halter tied fast about the arm of the servant, the horse being wild and not broken, starting aside, unhorsed the man and drew him by his arm about a great field so long that what with striking, what with drawing, haling and pulling, being wearied he stood still until company came and unloosed the halter, and took up the man half dead and conveyed him unto his master's house. Chirurgeons were sent for who finding the servant speechless and without remembrance of any one whom he saw departed and left him for uncurable. Mr. Wroth sent for me and I seeing him speechless and without remembrance conjectured the hinder part of the head to be hurt and smitten of the horse, which I was more certain of when feeling that part I found it soft. Wherefore I, taking off the hair, did first make incision and after that set a trepan on his head and bored the cranium through and took out the piece of bone; which done, there issued out much blood, black in colour. The next day following the servant spake and came again to his perfect remembrance and I using things in this cure as art required God restored the man in my hands to his perfect health." To this John Yates replies: "This was a worthy cure and this is a noble instrument."

Inflammation and ulcers are then spoken of, and afterwards hernia. John Yates asks: "And what judge you Epiplocele to be?" John Field answers: "I will not only speak of that but also of the other kinds of Hernia. An epiplocele is a tumour coming when the Omentum falleth into the purse of the testicles. And by the like reason Enteroccele taketh its name when the intestines fall into the aforesaid place. And enteroepiplocele followeth when both Omentum and the intestines fall into the scrotum or purse of the testicles. Furthermore Bubonoccele happeneth when the Peritoneum is ruptured or wounded by the flanks. Exomphalos is a tumour pertaining to the overthwart muscles of the Abdomen, which being relaxed there followeth a starting or eminence of the navel." Master Gale cuts short the discussion with the remark: "My brother Yates doth the more readily conceive the differences of these kinds of Hernia for that he hath a peculiar way of curing some of them, especially of Enteroccele, wherefore we will no longer stand in uttering the differences of them."

Of fractures Thomas Gale says: "There be two kinds of fractures, a simple fracture and a compound fracture.

"JOHN YATES: What is a simple fracture?"

"JOHN FIELD: A simple fracture is a solution or division of continuity made in a bone without any other affect joined with it.

"JOHN YATES: What is a compound fracture?"

"JOHN FIELD: It is also a solution of unity made in the bone, having one or more affects to it connected and joined.

"JOHN YATES: How many differences be there of fractures?"

"THOMAS GALE: You must note that like as there be simple and compound fractures, so in like manner there be differences of fractures both simple and compound. Wherefore let me know of which fracture you would know the difference?"

To which John Yates in assumed humility replies: "I would right gladly understand all the differences, although for want of knowledge I cannot orderly demand of you. Wherefore I pray you first to begin with the differences of simple fractures and then to the compound", which Thomas Gale does at some length.

Then comes the question of the suture and dressing of wounds, about which John Yates says: "I pray you let no time herein be lost for loth I were to depart without the knowledge of them and for that you first made mention of stitching I pray you first begin with it." Thomas Gale describes three kinds of suture, and John Field says: "the needle must be long and small, being three square, the eye hollowed in that the thread may the more easily follow." And John Yates sums up the whole matter of the discourse by saying: "I will repeat in brief words so much as I can remember". The dialogue ends by Thomas Gale inviting them to supper. "And now behold, we be come to the City. Wherefore we will now leave off talk here and you both shall this night take part of such cheer as God hath sent me, and let us recreate our spirits and be merry I pray you.

"JOHN FIELD: I thank you heartily, Sir, and I rejoice that my brother Yates hath so firm and perfect a memory. God send more such to follow Chirurgery.

“JOHN YATES : I thank you both for the great benefit I have received at your hands and God grant me to spend many days in this sort.”

Gale must have been a thoroughly good fellow as well as a good surgeon, for we read that in 1562—the year before this treatise was published—there was a great (archery) shooting of the Barber-Surgeons for a great supper at their own hall and they had six drums playing, and a flute and two great flags, and as a shot was won down went one and up the other, and Master Gale and his side won the supper. His teaching was sound and was the result of experience in war. He says in his *Treatise on Gunshot*, after quoting cases where he had exercised a masterly inactivity and the patient had recovered : “These I do bring forward only for example’s sake, that other Chirurgions being in the wars should not too much busy themselves or put the patient to pain and in danger in taking out the shot.”

Gale’s treatises are less raey than those of John Arderne. They contain, too, somewhat more theory and less personal experience ; but they are full of sound common sense, and the teaching is well suited to those whose surgical knowledge was of the slightest.

SOME NOTES ON THE CLINICAL FEATURES AND THE DISTRIBUTION OF SECONDARY DEPOSITS IN BONE FOLLOWING CARCINOMA OF THE BREAST.

BY D. H. PATEY,

SURGICAL REGISTRAR, MIDDLESEX HOSPITAL, LONDON.

THE appearance of bony deposits secondary to carcinoma of the breast is as a rule regarded by the surgeon as an indication that the disease has passed out of his province. The patients tend to drift to infirmaries, or to special homes for inoperable malignant disease, or are attended by their family doctors at home until death supervenes. In any case, they are very often lost sight of by the surgeon unless he is connected with some such institution as the above. It was therefore thought that an account of some of these patients would prove of value.

The series here recorded consists of eighteen cases which have come under observation and treatment at the Middlesex Hospital since October, 1924. They may be accepted as representative examples of the varieties of this condition seen at the above institution, though they by no means constitute the total number of cases which have presented themselves during this period, a considerable number being lost sight of after the diagnosis has been established. For descriptive purposes, they may be subdivided into three categories: *Group A*—represented by *Cases 1 to 10*—this, for reasons to be discussed later, may be called the 'diffuse' group; *Group B*—represented by *Cases 12 to 18*—the 'localized' group; *Group C*—represented by one case only, *Case 11*—the 'mixed' group, so called because the features of both former groups are combined.

GROUP A: THE 'DIFFUSE' GROUP. CASES 1 TO 10.

The essential feature of this group is the widespread nature of the bony deposits (well shown in *Figs. 128-137*), and this can only be adequately demonstrated clinically by a complete bony X-ray examination. In the earlier cases local X-ray examinations only were made of suspected parts of the skeleton. This probably resulted in the non-appreciation of the widespread nature of the disease, for when the complete examination was made deposits were frequently found in bones where they were least expected. For example, unsuspected deposits were demonstrated skiagraphically in the scapula and humerus regions in *Cases 4, 5, and 9*, and in the pelvic bones in *Cases 5 and 6*. For this reason a whole skeleton examination is necessary where exact knowledge is required; but, as the bones below the knee and elbow are so rarely involved, they may, from motives of economy, be exempt from routine examination unless there is some special indication.

The interpretation of the radiograms requires the co-operation of a radiologist. Usually the X-ray signs are so definite that diagnosis is easy, but in the earlier stages an expert opinion is advisable. Even then it is often impossible to be dogmatic, and one can only note the presence of suspicious rarefied areas, and re-examine at a later date, and in several cases of this series it was found that the re-examination enabled a tentative diagnosis to be converted into a positive. At every opportunity X-ray findings should be checked by post-mortem examination.

Relationship to Operation.—Three cases of this series (*Cases 5, 9, and 10*) developed their bony deposits before the diagnosis of the primary breast tumour was made. *Case 10* had been treated in two other hospitals for tuberculous disease of the spine, and *Case 9* was diagnosed as suffering from 'back strain', and in both the primary breast tumour was not noted either by the doctor or the patient until the result of the X-ray examination caused a routine search to be made for a primary growth. There appears to be something peculiar about these growths which makes them more liable to metastasize than to form a prominent local mass. Thus, at the present time, two years after the bony deposits were discovered, the primary tumour of *Case 9* is still in what would be an operable condition were it not for those deposits. The remaining seven cases of this group had had an operative removal of the primary growth, and in all except one the bony recurrences became manifest within the first twelve months or so following operation. This was associated with local or glandular recurrences in four cases (*Cases 2, 3, 7, and 8*), and unassociated in three cases (*Cases 1, 4, and 6*). The state of the latter patients is usually the more comfortable owing to the absence of what tends to become a foul, sloughing mass of growth, and for this reason life is often longer.

Distribution.—

Pelvis.—The pelvic bones are particularly liable to involvement. In every case of the 'diffuse' group, except *Case 7*, deposits were demonstrated in these bones. Sometimes the whole pelvis is infiltrated with growth, but often certain areas are specially affected, the two chief being (1) the region of the sacro-iliac joint, and (2) the pubic and ischial rami and the neighbourhood of the acetabulum. The latter site is often associated with involvement of the head, neck, and upper end of the corresponding femur. Pelvic bone deposits are in the majority of cases symptomless, giving no evidence of their presence until the X-ray examination. In some, suspicions may be aroused by such symptoms as gnawing pains often referred to the upper part of the thigh. In the later stages (e.g., *Case 9*) there may be a falling in of the affected side of the pelvis, as a result of which the corresponding trochanter is less prominent.

Scapula.—Deposits are not infrequently found in this bone. As in the pelvis, they tend to be 'silent' clinically, though of somewhat rarer occurrence. The cancellous tissue near the glenoid cavity appears to be the favourite site. With this is often associated growth in the upper end of the humerus.

Ribs.—The ribs were affected in this series in the more diffusely involved cases such as *Case 5* and *Case 9*.

Spine.—The vertebral bodies are common sites for metastases, as will

be seen from the diagrams. The lumbar region is the earliest and most markedly involved. As a rule the disease affects a number of adjoining vertebræ, but in one case, *Case 7*, one vertebra only, the 3rd lumbar, was involved. This, however, would appear to be exceptional. Only a minority of cases showed signs of pressure on the cord. Thus *Cases 3, 4, 6, 9, and 10*, all of which had well-marked spinal recurrences, showed no cord symptoms. *Cases 1, 7, and 8*, on the other hand, developed pressure signs, *Cases 1 and 8* having paraplegia with urinary retention, and *Case 7* pressure symptoms of a temporary nature only. Some of the more diffusely involved spines, e.g., *Cases 4 and 6*, developed a generalized progressively increasing kyphosis. This made it technically difficult to define precisely the outline of the vertebræ on radiographical examination.

Femur.—Deposits were noted in the head, neck, and upper end of the femur in several instances. There is no example of spontaneous fracture as a complication in this series, possibly owing to the early recognition of the presence of growth, and the consequent avoidance of weight-bearing and other traumata. The lower end of the femur was involved in one case only, *Case 10*.

Peripheral Bones of the Lower Limb.—In no case was growth found in the bones below the knee.

Humerus.—Deposits were present in the upper end of this bone in *Cases 4, 5, and 9*. This lesser susceptibility as compared with the femur runs parallel with the same feature in the scapula as compared with the pelvic bones.

Peripheral Bones of the Upper Limb.—No growth was found below the middle of the humerus.

Skull.—The skull was not radiographically examined in a sufficient number of cases to justify any conclusions; but though clinically no case gave evidence of deposits, extensive invasion of the vault was present in *Case 5*, and a suspicious rarefied area in *Case 6*.

The present study, therefore, confirms post-mortem figures¹ in showing the comparative freedom from recurrence of the peripheral bones of the limbs. Since the present series was collected, however, one case has come to post-mortem with diffuse involvement of the tibia, but this is probably exceptional.

Prognosis.—By the time that the disease has become so widespread as to involve diffusely the skeletal structures, the ultimate prognosis is, of course, hopeless; but the condition is compatible in some instances with months or even years of fairly comfortable life. Thus, *Case 6* is still (July, 1927) alive and comfortable, though the deposits shown in the diagram were present in September, 1925, and *Case 9* is alive and in fair general health, though it is probable from the history that the bones have been involved since February, 1925. Death occurs from exhaustion and asthenia, coming more quickly in cases with visceral deposits and in patients with signs of pressure on the spinal cord. If these are absent, however, an early death need not necessarily be anticipated.

Treatment.—This is usually palliative only, sedatives being given for the pain, and general nursing measures instituted. Some complications, as spontaneous fracture and pressure on the spinal cord, should be anticipated, and treated by rest in bed, and a spinal jacket where necessary. Posterior

root section was done in one instance (*Case 1*), but failed to give any relief. As it is a diffuse condition, such localized therapeutic measures as surgery or radium are of little value, and on theoretical grounds, if ever the cure of these cases becomes possible, it would seem that it must be through some general therapeutic agency. In rare cases, such as *Case 7*, when the symptoms are due to a deposit in one bone, marked temporary improvement may be obtained by deep X-ray therapy. This patient had growth in the 3rd lumbar vertebra only, and before treatment was confined to bed, unable to walk, and had marked difficulty with micturition. Following a course of deep X-ray treatment by Dr. Webster, she was able to walk about the ward, and even returned home for a holiday. This was accompanied on X-ray examination by a compressed and almost obliterated 3rd lumbar vertebra. Later, however, death resulted from visceral recurrences.

GROUP B: THE 'LOCALIZED' GROUP. CASES 12 TO 18.

The essential feature of this group, in contradistinction to the previous one, is the development of a deposit in one or more of the bones adjoining the field of the primary growth, i.e., the sternum or the ribs. The whole process, therefore, remains relatively local, and is open to successful attack in the early stages by such local therapeutic agents as radium. One case, *Case 12*, is an example of a local rib recurrence, and, following the treatment of this by radium, no other lesion has occurred. The remaining six cases are intercostosternal recurrences, the main features of which, and their treatment by radium, have been described by Handley.² Briefly, one notes the appearance of a swelling at the junction of the ribs and sternum, usually on the same side as the primary breast tumour (*see Fig. 139*), and it may be years after operation. Thus in *Case 15* it was seven years, and in *Case 16* twelve years. The mass, if untreated, continues to grow, and may eventually ulcerate to form a foul discharging sore as in *Case 15*, and may also spread deeply towards the mediastinum. The first indication of this clinically, e.g., *Case 14*, is often hoarseness of voice due to pressure on and paralysis of the left recurrent laryngeal nerve. Death supervenes in the majority of cases as a result of the mediastinal spread. If treated at an early stage, however, complete disappearance of the growth may occur; or, failing this, the tendency to ulceration superficially may be abolished, allowing death to take place with less pain and discomfort from the mediastinal spread. The problem, therefore, is completely different from that of the 'diffuse' group, in that the disease, though often deeply rooted, remains relatively localized.

GROUP C: THE 'MIXED' GROUP. CASE 11.

This group consists of one case only (*Case 11*), in which the features of both preceding groups are combined. This patient, in January, 1924, was treated with buried radium for an intercostosternal recurrence, following which she remained quite well and apparently free from growth until October 1926, when deposits in the 2nd to the 5th cervical vertebræ were demonstrated. A radiogram was taken of the pelvis at this time as a routine measure,

although no suggestive symptoms were present, and a very early growth was found in the right ilium. Now (March, 1927), six months afterwards, pain in the region of the right hip is being complained of. This case is of great interest in that, in the same patient, we have the combination of the 'localized' type of bony deposit with 'cure' following the use of a local therapeutic agent (i.e., radium), and the 'diffuse' type for which only palliative measures can be adopted.

DISCUSSION.

Since the two processes are clinically so distinct, it is probable that their pathology is equally so. The localized intercostosternal recurrence may arise theoretically in two ways: first, by direct spread from the overlying permeated lymphatic plexus; or, secondly, from the internal mammary chain of glands which have been invaded either directly or retrogradely from the supraclavicular glands. The second theory is the more probable, as it better explains the great liability to mediastinal spread.

The 'diffuse' type of bony recurrence, on the other hand, results from some diffuse method of spread, either lymphatic according to Handley, or blood-borne as concluded by Piney.³ From the clinical nature of this investigation, no conclusions can be here offered on this pathological point. The comparative youth of some of the cases of the 'diffuse' group is rather in favour of the blood-stream agency. On the other hand, the tendency which some cases (e.g., Cases 3, 4, and 9) show to greater involvement of the bones on the side of the primary breast tumour would rather support the lymphatic route. But the cases are too few to justify any conclusions on this score: all that can be said is that the deposits result from some diffuse process.

CASE REPORTS.

Case 1.—H. H., age 61. Radical removal of the left breast elsewhere in 1922. Twelve months following operation, she commenced having girdle pains and difficulty in walking. Five weeks before admission to the Cancer Wing she had had division of the posterior nerve-roots without any very marked benefit.

On examination in October, 1924, there was no evidence of local or glandular recurrence; complete paraplegia, with retention of urine and incontinence of faeces. Some weeks after admission thickening was noted in the region of the great trochanter of the right side. Discharged home November, 1924, rapidly going downhill.

X Rays: Local examination only made, lower dorsal region and right hip-joint. and showed: (1) Infiltration and collapse of the 9th dorsal vertebra; (2) Early deposits of growth in the region of the trochanter and neck of the right femur and the right descending ramus of the ischium. (*Fig. 128.*)

Case 2.—E. H., age 41. Radical removal of the left breast elsewhere in August, 1924. May, 1925: left-sided supraclavicular glands removed. August, 1925: the patient began to suffer from shortness of breath and cough, and stiffness of the left arm and leg.

Examination in October, 1925, showed scar recurrences, ulcerated recurrence to the left side of the upper part of the sternum, and chain of glands in the left posterior triangle.

X Rays showed (from upper dorsal spine to top part of pelvis): (1) Extensive secondary deposits in the chest; (2) Extensive deposits in both pelvic bones and the sacrum; (3) Definite deposits in the last lumbar vertebra, and ? early deposits in the upper dorsal vertebrae. (*Fig. 129.*) Discharged at own request Nov. 4, 1925.

In all Diagrams {
 = Well marked X Ray evidence
 of Deposits
 = Suspicious rarefied areas

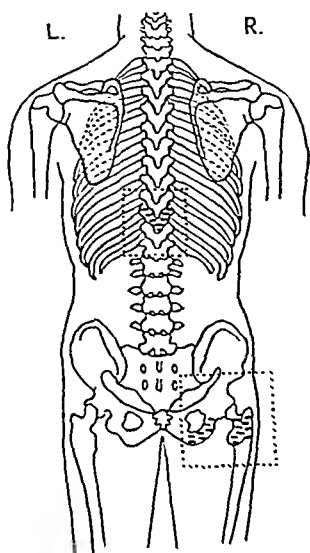


Fig. 128.—Case 1. Local X-ray examination within areas of dotted lines.

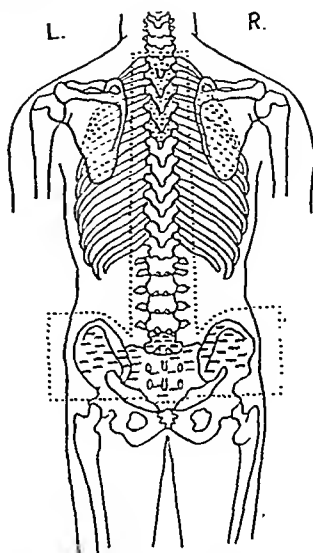


Fig. 129.—Case 2. X-ray examination of areas within dotted lines only.

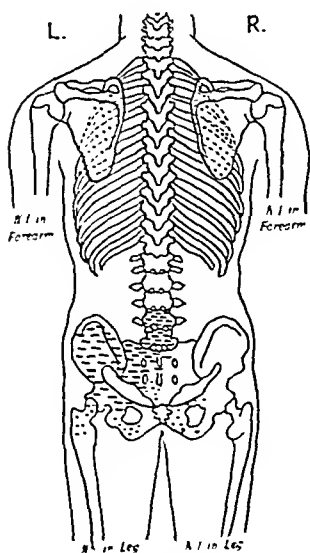


Fig. 130.—Case 3. Complete X-ray examination.

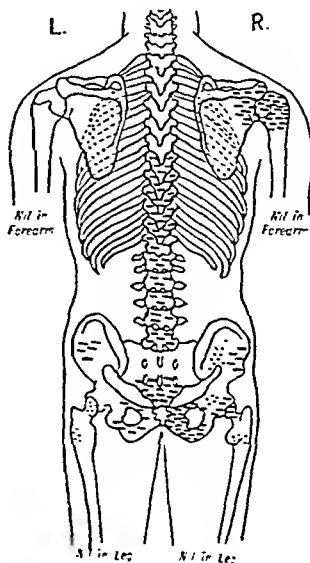


Fig. 131.—Case 4. Complete X-ray examination.

Case 3.—M. E., age 50. Radical removal of the left breast elsewhere in February, 1925. Recurrence in right breast, and palliative removal of this breast in June, 1925.

On examination in October, 1925, multiple nodular skin deposits were found on the chest, chiefly at the front and sides, more marked on the left side. No demonstrable glandular or visceral recurrence. Discharged at own request.

Heard of in August, 1926—still alive, but in pain.

X Rays: Complete X-ray examination made, showing: (1) No evidence of deposits in any of the peripheral bones of the limbs; (2) Deposits 4th and 5th lumbar vertebrae; (3) Deposits in sacrum and ilium in the region of the right sacro-iliac joint; (4) Suspicious area in head and neck of the right femur. (*Fig. 130.*)

Case 4.—R. G., age 41. Radical removal of the right breast elsewhere in May, 1925. Admitted to Cancer Wing Nov. 30, 1925, on account of general asthenia, and progressively increasing dorsal kyphosis, which in the first instance was stated to be an adolescent condition. Gradually went downhill, the deformity of the spine increasing, but no evidence of pressure on the cord developing; died May 20, 1926, with symptoms suggestive of intrathoracic recurrence. Patient had no evidence of local or glandular recurrence. Post-mortem refused.

X Rays: Complete X-ray examination made, showing: (1) Deposits in the lumbar vertebrae, and most of the upper dorsal vertebrae (difficult to define owing to the deformity); (2) Deposit in the 10th right rib; (3) Diffuse deposits scattered all over the pelvic bones; (4) ? Early involvement head and neck of left femur, and more definite involvement of the right femur; (5) No involvement of the bones below the middle of the humerus or the femur; (6) Deposits in right scapula and humerus region. (*Fig. 131.*)

Case 5.—E. B., age 36. Lump in right breast eight months before admission, not diagnosed as carcinoma until a gland was removed from the supraclavicular triangle at another hospital, and microscoped. Almost simultaneously with the development of the lump, had pain in the side, which was diagnosed as pleurodynia, and pain in the lower part of the back and the left leg. Admitted to Cancer Wing Aug. 24, 1926.

On admission two carcinomatous masses were found in the right breast, not attached to the skin or deeper tissues, and about $1\frac{1}{2}$ in. in diameter. Glands in both axillae and supraclavicular fossae, more marked on the right side. Liver not palpable, and no evidence of abdominal recurrence. General condition very wasted, and ill looking. Died of asthenia Nov. 19, 1926.

X Rays: Complete bony X-ray showed: Deposits in all the bones of the body except the bones below the knee and the elbow. (*Fig. 132.*)

Case 6.—A. H., age 46. Operated upon in 1920 elsewhere—radical removal of carcinoma of the left breast.

Admitted September, 1925, with pain under the right costal margin. Simulated gall-bladder disease; cholecystogram gave negative result. On examination there was no evidence of local or glandular recurrence. General condition appeared excellent. Has continued in fair health until the present time (January, 1927), the only alteration being a gradually appearing dorsal kyphosis, which even now is only slight in degree.

X Rays: Complete bony X-ray showed: (1) Deposits in the spine from the 4th dorsal to the sacrum, being well marked in the 7th dorsal to 1st lumbar; (2) Diffuse infiltration of all pelvic bones; (3) Suspicious rarefied areas in head and neck of both femora; (4) No bony deposits below the knee or the elbow. (*Fig. 133.*)

Case 7.—E. S., age 45. November, 1924: radical removal of left breast elsewhere. September, 1925: glands in the left supraclavicular region, to which X rays were given. December, 1925: was confined to bed with pain in lumbar region and pelvis and in the thighs. Marked difficulty in micturition.

On examination local recurrence was found in scar of operation, and in the left supraclavicular fossa. Deposit in 3rd lumbar vertebra. Treated by X rays

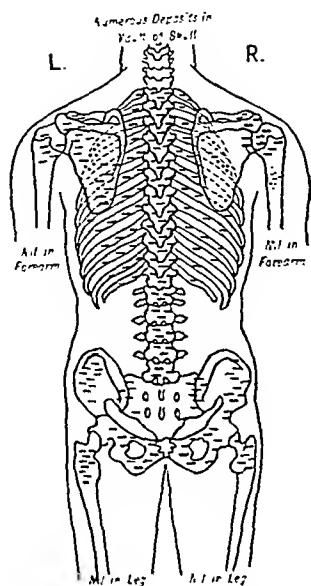


Fig. 132.—Case 5. Complete X-ray examination.

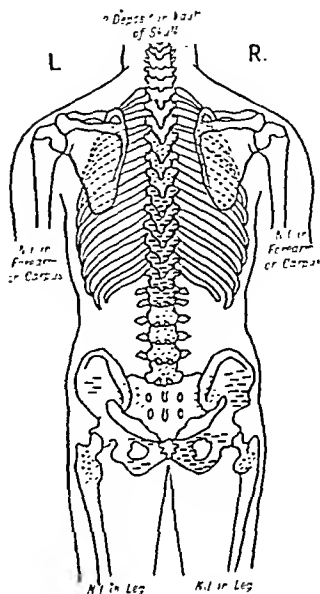


Fig. 133.—Case 6. Complete X-ray examination.

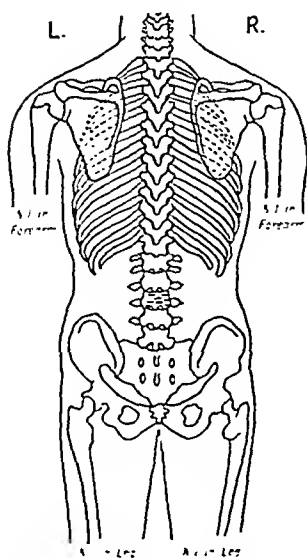


Fig. 134.—Case 7. Complete X-ray examination.

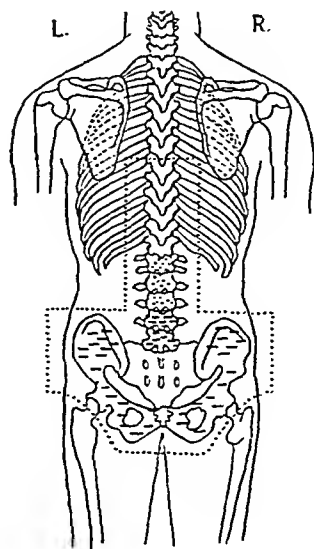


Fig. 135.—Case 8. Local X-ray examination only within area of dotted lines.

both locally and to the lumbar spine. Condition improved remarkably, and patient was able to get up and walk about, and went home for a holiday.

On readmission local recurrences began to increase in size rapidly, a mass developed in the left axilla, and the patient gradually went downhill and died of asthenia July 30, 1926.

X Rays: Complete examination showed deposit in the 3rd lumbar vertebra (*Fig. 134*). Post-mortem confirmed X-ray finding.

Case 8.—I. E., age 33. Radical removal of carcinoma of the left breast in this hospital in January, 1925. Had subsequent X-ray treatment. Was readmitted June, 1926, with wasting and pain in legs.

On examination, paralysis of both lower limbs, some skin nodules around the operation scar, and the liver was just palpable.

X Rays, local only: Deposits in the pelvis and the lumbar spine (*Fig. 135*).

Case 9.—K. E., age 48. Operation April, 1923, for gastric ulcer and cholecystitis. In February, 1925, complained of pain in lumbar spine and pelvis following a blow: ordered massage and electrical treatment. July, 1925: lump in the right breast first noticed. Admitted to the Cancer Wing October, 1925.

On examination a lump about 1 in. in diameter was found in the upper and outer quadrant of the right breast. Not attached to skin or deep fascia. No glands, or evidence of intrathoracic or abdominal deposits. Bones: *see Fig. 136*. Has remained much the same until the present time (July, 1927). The lump in the breast has increased a little in size and is now definitely attached to the skin, but no other palpable deposits have developed.

X Rays: Showed deposits as in the appended diagram (*Fig. 136*).

Case 10.—M. D., age 29. Admitted June 13, 1926, for pain in the left hip region and in lumbar spine. Had been treated in one hospital in November, 1925, as case of sciatica, and at another as a case of tuberculosis of the hip. It was only after the X-ray examination that a carcinoma of the breast was suspected, and a typical carcinoma of the upper and outer quadrant of the right breast was discovered.

X Rays (peripheral bones not taken): (1) Diffuse deposits were seen throughout the whole of the spine, most marked in the 8th dorsal, which was collapsed, the upper dorsal region, and the last lumbar vertebra; (2) In the pelvis and upper ends of the femora, much more marked on the left side, the head and neck of the left femur being almost destroyed; (3) In the lower end of the left femur. (*Fig. 137*.)

Case 11.—E. W., age 67. Operation for carcinoma of the left breast May, 1923, elsewhere. December, 1923: came to the Cancer Out-patient Department with intercostosternal swelling at junction of 1st and 2nd pieces of sternum. Treated in January, 1924, by buried radium.

October, 1926: complained of pain and stiffness of the neck. X rays showed deposits in the 2nd to the 5th cervical vertebrae, with collapse of the 2nd. Now in Cancer Wing fitted with a poroplastic jacket. Pain in neck relieved, and general condition very good. No evidence of sternal or other recurrence.

X Rays: (1) Deposits in the cervical vertebrae as noted above; (2) Pelvis—very early deposits in the right ilium. (*Fig. 138*.) No general X-ray examination performed. Later, died May, 1927, with liver recurrences.

Case 12.—E. E., age 54. August, 1924: operation for carcinoma of the right breast elsewhere. July, 1925: came to the Cancer Out-patient Department with a nodule fixed to the 3rd rib in the right anterior axillary line. X-ray of chest negative. No other signs of recurrence.

Treated by superficial radium, and when last seen, in January, 1927, quite well and free from recurrence.

Case 13.—K. G., age 46. In 1921, elsewhere, there had been a partial removal of the right breast for carcinoma.

Admitted in March, 1924, with intercostosternal recurrence at junction of 1st

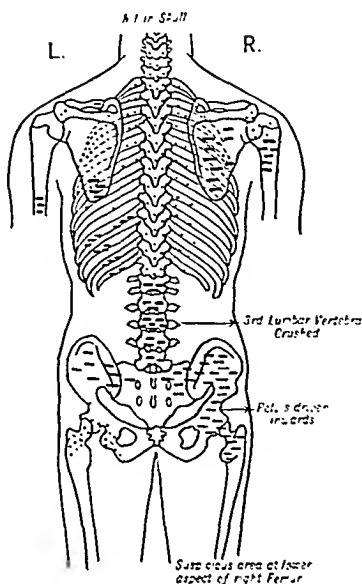


Fig. 136. — Case 9. Complete X-ray examination, excluding forearm and leg bones.

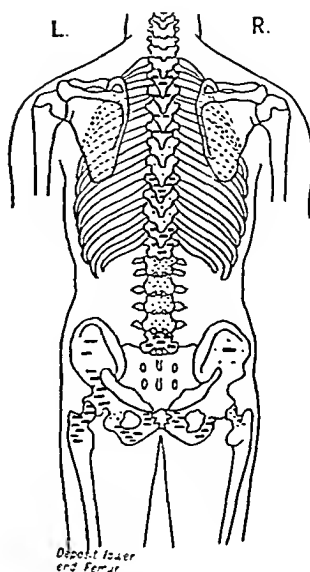


Fig. 137. — Case 10. Complete bony X-ray examination, excluding forearm and leg bones.

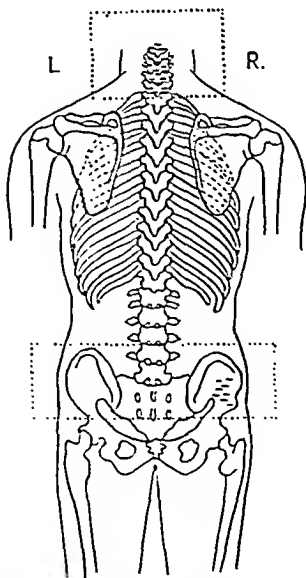


Fig. 138. — Case 11. Local X-ray examination, within area of dotted lines.

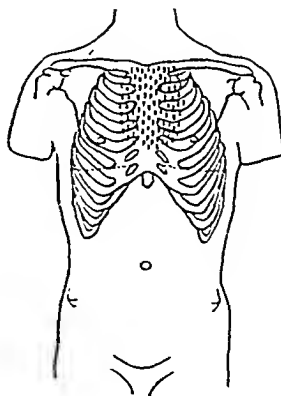


Fig. 139. — Showing the area within which the intercostosternal recurrences occur, usually on the same side as the primary breast tumour (cf. Cases 12-18).

and 2nd costal cartilages with the sternum. Treated by buried radium by the encirclement method. Mass totally disappeared, but in November, 1924, a further treatment with radium was carried out owing to a small recurrence. Died at home with symptoms suggestive of mediastinal recurrence February, 1925.

Case 14.—M. A., age 77. Removal of the left breast elsewhere for carcinoma in 1921.

May, 1924: intercostosternal recurrence left side, in region of 2nd costal cartilage and 1st intercostal space. Recurrence disappeared. Remained quite well until April, 1925, when hoarseness of voice due to a paralysis of the left recurrent laryngeal nerve developed. Died in February, 1926, and post-mortem showed growth in anterior mediastinum spreading to the roots of the lungs, and in the supraclavicular triangles.

Case 15.—K. M., age 57. Operation for carcinoma of the left breast in 1917.

Readmitted November, 1924, for ulcerated sternal recurrence on the left side at the junction of the 2nd costal cartilage and 2nd intercostal space with the sternum. Treated on two occasions with buried radium, and mass disappeared.

Last heard of in November, 1925, when she had difficulty in breathing and cough, suggesting the presence of mediastinal secondaries. Presumed dead.

Case 16.—M. S., age 66. Removal of left breast for carcinoma in 1912 elsewhere.

November, 1924: intercostosternal recurrence at the junction of the 2nd costal cartilage and 2nd intercostal space with the sternum on the left side. Treated on two occasions with buried radium by the encirclement method, and lump disappeared. Mass did not recur, but later symptoms of mediastinal deposits appeared, and when last heard of, in June, 1926, patient appeared to be dying from this cause.

Case 17.—A. K., age 66. Left breast removed for carcinoma in 1907 elsewhere. At the beginning of 1926 a swelling was noticed at upper part of sternum, and left supraclavicular fossa.

On admission, November, 1926, there was an elevated intercostosternal recurrence at the junction of the 1st left costal cartilage with the sternum, and two hard supraclavicular glandular nodules. Treated by buried radium. Too early to determine end-results.

Case 18.—E. G., age 63. Removal of left breast by Mr. Handley in 1908 at the Bolingbroke Hospital. Treated in 1918 by buried radium for intercostosternal recurrence in the region of 3rd and 4th costal cartilage.

Remained quite well until 1926, when mass reappeared for which X-ray treatment was ordered, since which the swelling has become smaller.

I have much pleasure in acknowledging my indebtedness to the surgeons of the Middlesex Hospital for permission to use cases, to Dr. Douglas Webster for helpful criticism and use of material, to Dr. Nicholas for much help in the interpretation of the radiograms, and especially to Mr. Sampson Handley, under whose care were most of the patients, for permission to use cases, and for constant help and guidance in the preparation of the paper.

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NEW OPERATION ON DROP-FOOT.

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THOUGH successful operations have been devised for almost every deformity of the foot, an entirely satisfactory one for the relief of drop-foot has not yet been found.

Tenodesis is unsatisfactory because the tendon invariably stretches. Astragalectomy with backward displacement of the foot, though excellent for a flail-foot, is not successful where the gastrocnemius is active, because the backward displacement lengthens the lever, and thereby increases the power of the muscle whose over-action it is desired to correct. The same applies to Dunn's operation. Arthrodesis of the ankle-joint is useful in some cases; but, since a large number of paralytic drop-feet are also associated with unstable subastragaloid joints and consequent valgus or varus deformity, arthrodesis of this joint is also required. This double arthrodesis produces an extremely rigid and uncomfortable foot, and on the whole is not recommended by orthopædic surgeons.

A year ago, at the Meeting of the British Orthopædic Association at Manchester, Ollerenshaw showed cases of the bone-block operation originally recommended by Campbell in America. This consists in excising the scaphoid, displacing the foot backwards, arthrodesing the subastragaloid joint, and making a pillar of bone with a graft at the back of the os calcis. The foot is stable and the patient walks very well; but, looking at the skiagrams in Campbell's original paper in the *Journal of Bone and Joint Surgery*, I am impressed by the fact that the graft looks extremely attenuated and atrophic. That this graft should undergo a pressure atrophy seems a reasonable thing to expect. I cannot think of any joint where two bones coming together, as a natural mechanism of locking, are not covered by articular cartilage. If the constant pressure of an aneurysm will erode the sides of the bodies of the vertebræ, it seems likely that the constant pressure of the tibia will do the same to the small graft. Indeed, Ollerenshaw reported that in two or more of his cases the graft had fractured.

Principle of the New Operation.—The normal locking of the ankle-joint in full equinus is produced by the posterior tubercle of the astragalus coming in contact with the posterior margin of the articular surface of the tibia, both covered by cartilage. This is a natural bone-block, and more effective than any bone-graft possibly could be. Consequently, if the ankle-joint remained locked in full equinus, and the correction were made for the deformity at the joint below, the foot could not drop any further. The idea originally occurred to me after experiencing great difficulty in correcting a paralytic equinus of long standing. Eventually, after having recourse to open division of the posterior ligaments of the ankle-joint, I succeeded; but, in order to

maintain my correction, the patient was obliged to wear steel supports and a toe-raising spring. In other words, I had converted a stable condition into an unstable one. It would have been wiser had I allowed the ankle-joint to remain fixed as it was, and made the correction at the subastragaloid joint. With this object in view, the following operation has been devised.

Description of the Operation.—A J-shaped incision is made, starting 4 in. above the external malleolus, close to the posterior margin of the fibula, carried down below the external malleolus, and ending at the centre of the

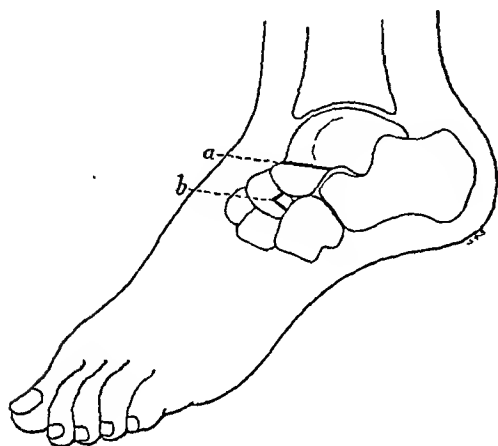


FIG. 140.—Showing the portions of bone removed: *a*, From the astragalus; *b*, From the scaphoid.

FIG. 141.—Position of the bones after operation.

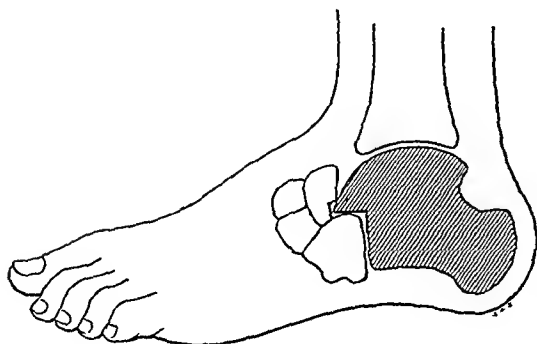
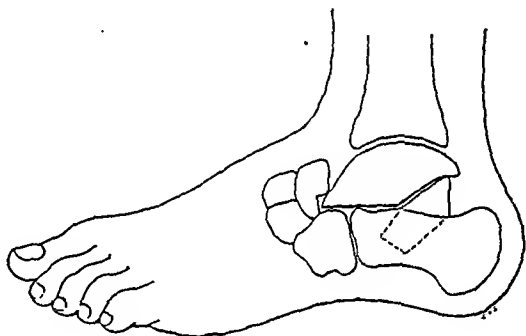


FIG. 142.—Final condition after fusion.

middle metatarsal bone. The skin, together with all the soft parts right down to periosteum, is dissected back *en masse* so as to expose the front and back of the ankle, great care being taken to leave intact the anterior and posterior ligaments of the ankle-joint itself. The peronei are divided low down and dissected up. The astragalo-scaphoid joint is next sought for, opened, and the knife is carried under the head and neck of the astragalus into the front part of the subastragaloid joint. The interosseous ligament is then divided, and the knife carried into the posterior compartment of that joint.

The subastragaloid joint is now sufficiently freed to allow the foot to be dislocated inwards, leaving the astragalus *in situ*. In order to mobilize the foot a little more, the soft parts are dissected away from the inner side of the astragalus. The cartilage is then removed from the upper surface of the os calcis and the lower articular surface of the astragalus, and a notch is made horizontally from side to side in the postero-inferior aspect of the scaphoid (*Fig. 140, b*). Then the head of the astragalus is depressed to its utmost limit, and the neck is sawn through in the direction of the black line *a* as shown in *Fig. 140*. The foot is next dorsiflexed, so that the cut surface of the neck of the astragalus lies on the upper surface of the os calcis, and the sharp anterior margin fits into the notch made in the scaphoid. The obliquity of the sawcut through the neck of the astragalus depends upon the angle at



FIG. 143.—Case that failed. Showing the cut surface of the neck of the astragalus pointing forwards instead of downwards.

which it is desired to set the foot. If the paralysis is complete, the foot should be set at an angle of 95° to the leg; if it is incomplete, it should be set in varying degrees of equinus, so that whatever power remains can be employed over a more useful range.

The angle produced between the articular surfaces of the os calcis and the astragalus, both denuded of their cartilage, is now filled up by a graft taken from the excised head and neck of the astragalus. This graft is not intended to act either as an intra- or extra-articular block, but is designed merely to increase the antero-posterior thickness of the astragalus when placed in this practically vertical position.

Fig. 141 shows the position of the bones as they should be after the operation, and *Fig. 142* the ultimate shape which the astragalus, os calcis, and graft are expected to assume when complete fusion has occurred. The foot is set at an angle of 95° to the leg, and cannot drop, because the ankle joint is locked in full equinus.

Type of Foot Suitable for Operation.—The first essential is that there should be good power in the gastrocnemius muscle. For reasons that have already been mentioned, other methods do not succeed where this muscle is active. This operation has been tried for almost all degrees of drop-foot, from complete paralysis of the dorsiflexors to partial paralysis associated with a valgus or varus deformity. If the deformity of the foot is marked, particularly if there is any fixed metatarsus varus, it is best to correct it by a preliminary operation or manipulation as the case may be. I have performed it 9 times,



FIG. 144.—W. W., age 8. Case of partial foot-drop. Photograph four months after operation.



FIG. 145.—An antero-posterior view of the same case as *Fig. 144*.

between the ages of six and sixteen; it has been completely satisfactory in 7 and failed in 2. These two failures were due to slipping of the astragalus as can be seen in *Fig. 143*. The best functional result is obtained in cases of partial paralysis, because it is then possible to place the foot at an angle which enables the patient to make better use of what power he has left (*Figs. 144–146*). In one case I transplanted the active peronei into the tibialis anticus and peroneus tertius, and set the foot at an angle of 100° , with a very good result (*Figs. 147–149*). Whether the paralysis is complete

or not, it is best not to set the foot at right angles to the leg, because it makes the wearing of an ordinary heel uncomfortable, and prevents the active gastrocnemius from coming into action when walking. If the foot is



FIG. 146.—Skiagram of same case as *Fig. 144* four months after operation.

set at 95° there is a range of passive dorsiflexion from 95° to 85° , and the gastrocnemius acting through even this small range gives some spring to the gait.



FIG. 147.—A. S., age 8. Case of complete paralysed dorsiflexors, but active peronei. These were transplanted anteriorly. Photograph shows range of plantar flexion.



FIG. 148.—Same case as *Fig. 147*. Showing active dorsiflexion by the planted peronei.

Prognosis.—The two important considerations are: (1) I tendency to dropping? (2) Is there a likelihood of a mechan

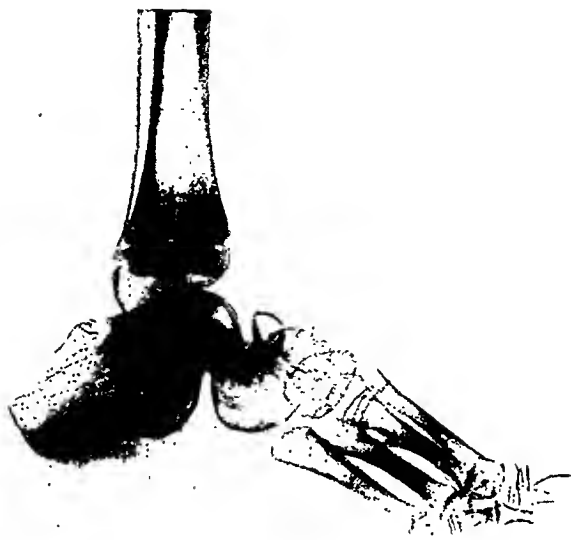


FIG. 149.—Skiagram of the same case as *Fig. 147* four months after operation.



FIG. 150.—S. P., age 12. Case of complete foot-drop with some action in the tendo Achillis. Walk with high-stepping gait. Skiagram taken immediately after operation.

at the ankle-joint? Time alone can give a final answer to these questions. The first operation of this kind was performed at the Balaam Street Hospital for Crippled Children, Plaistow, fifteen months ago (*Figs. 150-152*). It has withstood the test of that time extremely well; the patient walks in an ordinary boot, without a limp, and has no pain. In comparing *Fig. 150*



FIG. 151.—Skiagram of the same case as *Fig. 150* eleven months after operation.



FIG. 152.—Photograph of same case as *Fig. 150* fifteen months after operation.

and *Fig. 151* a tendency to drop at the midtarsal joint can be seen. It is, however, slight, and has not increased during the last six months. In order to overcome this tendency, I have modified the later operations and notched the scaphoid. This gives more security to the fore-foot without stiffening it too much. In none of the other cases has this tendency been noticed. In my opinion every effort should be made to avoid arthrodesing the midtarsal

joint. Even should a slight hypermobility occur at this joint, it is no disability; it can be controlled by wearing a boot instead of a shoe, and is more comfortable than a rigid foot.

With regard to the second question, the mechanical conditions at the ankle-joint are not such as would suggest a liability to the development of an arthritis. The relationship of the bones is normal; the method whereby they are locked is normal; and, so far as my personal experience goes, I do not remember to have seen a mechanical arthritis occurring in the ankle-joint secondary only to a persistent equinus gait, though I have often seen it occur at the midtarsal joint.

CONCLUSIONS.

1. This operation can control a drop-foot even though the gastrocnemius is active and powerful.

2. It permits of a certain range of movement at the ankle-joint, enabling the gastrocnemius to come into action during an important phase of the step forward, and at the same time keeps the foot up sufficiently for it to clear the ground.

3. Only one joint is arthrodesed—the subastragaloid.

FRACTURES OF THE UPPER END OF THE FEMUR.

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SINCE Sir Astley Cooper first wrote his classical account of these injuries at the beginning of the nineteenth century, so much has been written and said on the subject that perhaps an apology might be thought needed for discussing the subject once again. The reason is to be found in the fact that the description of them in the most recent text-books of surgery is untrue of the injuries as we see them in practice, the same errors being repeated again and again and many gross assumptions being accepted as true although there has never been any evidence produced to justify their acceptance.

The observations in this paper are based on the experience of 341 cases of fractures of the upper end of the femur which have been under the care of my colleagues and myself at Lambeth Hospital since 1912, and it is not necessary, therefore, to attempt to summarize the vast literature of the subject. As I am anxious, however, to point out and emphasize the common misconceptions, I must briefly refer to accounts of these injuries that are given in recent text-books, and it is instructive to compare them with Sir Astley Cooper's description of a hundred years ago. For it is a noteworthy fact that the erroneous statements that are commonly made to-day are repetitions of those made by Sir Astley Cooper, although a careful reading of his treatise shows that the general deductions that he made are not borne out by the cases which he describes so fully and from which he made them.

Sir Astley Cooper divides fractures of the upper end of the femur into : (1) Intracapsular fractures, which occur in elderly people between 50 and 80 ; (2) Extracapsular fractures at the junction of the neck and great trochanter, which occur in young people ; (3) Fractures through the great trochanter, which occur at every period of life. While such is his general description, the cases that he describes include an intracapsular fracture in a woman of 38 ; three cases of extracapsular fracture (the only three he mentions) at ages of 83, 68, and 60 ; and cases of fracture through the great trochanter in " a middle-aged man ", a patient of 46, and a girl of 16, the latter being a patient who, he says, was suffering from " constitutional symptoms evidently more violent than usually arise from fractured femur ", and at whose post-mortem, nine days after the injury, the hip-joint was found to be full of pus.

The recent text-books I have read vary slightly in their description of these injuries, but all more or less correspond to Kocher's division of them into five varieties : (1) Subcapital fractures ; (2) Fractures of the neck proper ; (3) Fractures along the anterior intertrochanteric line ; (4) Fractures of the great trochanter ; (5) Subtrochanteric fractures. The terms intracapsular and extracapsular are used, but most of the books point out that the terms are misleading. They all agree in saying that fractures of the neck occur as a

result of indirect violence, most commonly in elderly people, and in women more than men, and attribute their greater frequency in women to the fact that the neck of the femur in women joins the shaft at a greater angle than it does in men. They also all agree in saying that fractures through the outer part of the neck and through the great trochanter are the result of direct violence caused by falls or blows upon the great trochanter, and occur most often in young or middle-aged men.

In describing the signs of the injuries the text-books agree in saying that in fractures of the neck there is less shortening than in those through the great trochanter, wherein they differ from Sir Astley Cooper, who emphasizes the point that in 'intra-capsular' fractures the shortening is 1 to 2 in., while in 'extra-capsular' fractures there is little, if any, shortening.

In describing the results of these injuries, all the accounts agree that bony union of the fragments seldom or never occurs in fractures through the neck, and practically always is found in fractures through the great trochanter. Many ingenious theories are suggested to account for the failure of bony union in the former variety; but, as I shall have occasion to point out when discussing treatment, there is no reason to believe that the factors influencing union in these fractures are different from those with which we have to deal in fractures of any part of any long bone.

In the series of fractures with which this paper is concerned there are 341 fractures of the upper end of the femur. This figure excludes separation of the upper epiphysis of the femur in children, of which I have seen very few; avulsion fractures of the great trochanter and similar fractures of the lesser trochanter, both of which occur but would require separate consideration; and fractures due to neoplasms of the femur, which frequently involve the head and neck of the femur, but are outside the scope of this paper.

A consideration of the 341 fractures shows them to represent three, and only three, types of injury, differing from one another in the situation of the fracture, in the mechanisms that produce them, in the treatment that is needed for them, and in the results that may be expected from them.

1. Fracture through the Neck of the Femur (*Figs. 153, 154*).—In this type the fracture is purely one of the neck of the femur, and in the great majority of the cases the line of fracture runs transversely across the neck at its narrowest point. In a few cases the fracture is nearer to the head; it is never near the great trochanter, and there is seldom any comminution. The amount of displacement of the fragments varies greatly; in a few the fracture is little more than a crack, but in most of them there is a considerable elevation and rotation outwards of the lower fragment. The rotation outwards gives rise to a radiographic appearance of shortening of the neck, and has often led to the erroneous idea that the neck has been absorbed. The shortening of the limb produced by such a fracture as that shown in *Fig. 153* is at least $1\frac{1}{2}$ to 2 in., and sometimes more, and it may be seen that the upper edge of the great trochanter is above the upper edge of the acetabulum.

This type of fracture is, I believe, always produced in the same way, and no better description of the way in which it is produced can be found than that given by Sir Astley Cooper, who says: "I was informed by a person who had sustained a fracture of this kind, that being at her counter and suddenly

turning to a drawer behind her, some projection in the floor caught her foot, and preventing its turning with the body, the neck of the thigh bone became fractured". In some cases, such as those in which the foot slips off the kerb, it is the lower limb that is forcibly twisted outwards, the pelvis being held still. In each case the force producing the injury is an axial torsion of the lower limb, and the bone breaks at its weakest point—that is, the neck of the femur. It is easy to understand that the precise direction and position of the fracture may be influenced by the degree of abduction or adduction of the limb at the time of the twist, but the break will always be confined to that part of the femur that is running more or less horizontally inwards.



FIG. 153.—Fracture through the neck of the femur. A typical example.

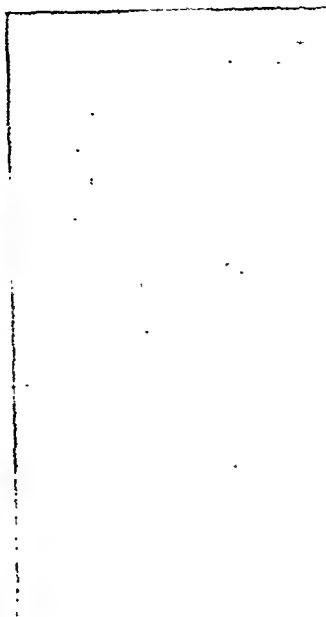


FIG. 154.—Shows a similar fracture to Fig 153, with the broken neck in profile riding high above the head of the bone.

2. Fractures through the Great Trochanter.—*Fig. 155* may be taken as a type of this fracture, but the anatomical arrangement of the lines of fracture in this class vary much more than they do in fractures of the neck. They all, however, have in common the characteristics that the fracture involves the great trochanter; that there is more or less comminution; that the angle which the neck makes with the shaft is decreased, generally to a right angle or less; and that there is considerable external rotation of the lower fragment, as may be seen by the profile view of the lesser trochanter.

This fracture is, I believe, always caused in the same manner, and here again I find the best description in Sir Astley Cooper's treatise, in spite of his views on the causation of this injury. In reporting his first case he says in his quaint way: "Mary Clements, *æt.* 83½, when walking across her room, October 1st, 1820, supported by a stick, which from the debility consequent

upon old age, she was obliged to employ, unperceived by herself, placed the stick in a hole in the floor, by which her balance was lost; and tottering to recover herself from falling—which she would have done but for those near her [please note those words]—she found she had as she supposed dislocated her thigh bone". He goes on to say that she had an extracapsular fracture. In this case there was no question of a direct fall on the great trochanter; he expressly says she did not fall, and I do not believe that any fracture through the great trochanter can be caused by a blow directly on that bone.

Fig. 156 shows what happens if a direct blow is given to the great trochanter with breaking force—the femur remains intact and the pelvis breaks at the acetabulum; if the force is greater, the head of the bone is driven through the acetabulum into the pelvis. There have been three such injuries in Lambeth Hospital during the time covered by this series,

and they are not included in the 341 cases with which this paper deals.

Fractures through the great trochanter are caused when a patient slips and the weight of the body is forcibly thrust on to the head of the femur when



FIG. 155.—Fracture through the great trochanter.

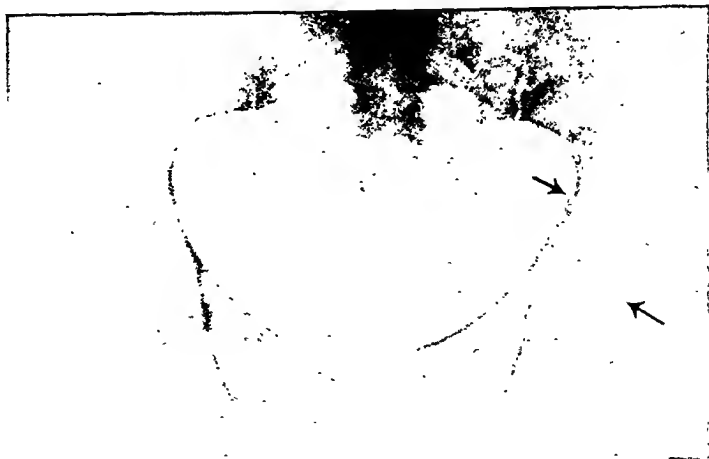


FIG. 156.—Fracture of the pelvis at the acetabulum caused by a direct blow on the great trochanter, but no fracture of the trochanter.

the limb is more or less adducted and slightly rotated outwards. The bone then breaks at the point where the shaft joins the head, and, because the bone there is largely cancellous, comminution occurs, the bone splintering in various directions. *Fig. 157* shows a case in which such a fracture occurred but was incomplete, and the fracture may be seen where the neck has bent on the shaft but stopped before the major injury has occurred. It would be impossible to conceive of such an injury being produced by a fall on the great trochanter.

Because the fracture occurs when the limb is adducted, the patient generally falls on to the injured side, and this fact has probably given rise to and perpetuated the erroneous view that direct violence causes this type of fracture. If additional evidence be needed that the breaking force is transmitted



FIG. 157.—Incomplete fracture through the great trochanter.

from the foot, it may be found in the fact that most patients with fractures of this type have traumatic synovitis of the knee-joint on the same side, a point that is often missed and to which I shall refer when writing of treatment.

As the fracture is caused by a forcible lessening of the angle which the femur presents at the great trochanter, the fragments are immediately driven together in such a way that the sharp lower edge of the upper fragment is driven into the broken surface of the lower fragment just above the lesser trochanter, producing such a fracture as that shown in *Fig. 158*. It will be seen that the lower point of the upper fragment is held in a V-shaped cleft just deep to the lesser trochanter,



FIG. 158.—Impacted fracture through the great trochanter; the lower edge of the upper fragment is driven into the broken surface of the lower fragment.

which is seen in profile because the lower fragment has rotated outwards as the upper fragment is ground into it. It is also noteworthy that the upper edge of the comminuted great trochanter is above the level of the upper rim of the acetabulum, necessarily giving rise to the same degree of real shortening of the limb as was seen in *Fig. 153*, a fracture of the neck. The fracture shown in *Fig. 158* is clearly an impacted fracture, but the breaking force does not always stop when the fragments have reached that position.

In *Fig. 159* the force has continued after impaction of the fragments, and the sharp edge of the upper fragment, acting like a chisel, has split the lesser trochanter off the shaft and caused a vertical fracture to run down the inner side of the shaft for about three inches. In this injury the fracture has become disimpacted, and the great trochanter is raised to a higher level than in any of the other fractures illustrated.



FIG. 159.—Fracture through the great trochanter in which the upper fragment has split the lesser trochanter off the shaft.



FIG. 160.—Comminuted fracture of the lesser trochanter, showing the displacement by the pull of the *psoas* muscle.

In *Fig. 160* the lesser trochanter, which is comminuted, has been pulled up high above its normal position by the action of the *psoas* muscle, and it was pointed out more than forty years ago by Sir Charters Symonds that it could be felt, clinically, in its new position as a bony swelling on the inner side of the thigh, thus giving a ready method of distinguishing between fractures through the neck and those through the great trochanter in the days when radiographs were not available.

Fig. 161 shows a rare injury, the only one in this series, in which the line of fracture runs through the great trochanter but leaves the lesser trochanter attached to the neck. In this case the break was caused by a sudden and forcible abduction of the lower limb while in a position of external rotation;

such a fall more often produces a subtrochanteric fracture than one through the great trochanter.

3. Subtrochanteric Fractures.—

These are really fractures of the shaft, and I do not propose to say much about them. This is the type of fracture that is often produced by violent abduction of the lower limb, but it no doubt results from other causes, such as 'run-over' accidents. It is well to bear in mind, when dealing with this class of fracture, that it is the commonest part of the femur in which fractures due to neoplasms are found.

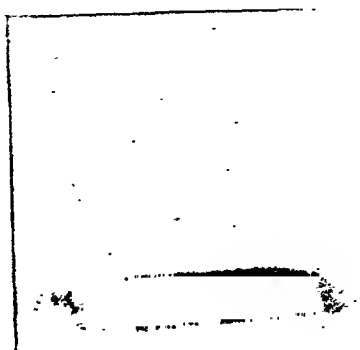


FIG. 161.—Fracture through the great trochanter in which the lesser trochanter is left attached to the femoral neck.

Accepting the above classification of fractures of the upper end of the femur, it is interesting to analyse the 341 cases and to see how they are divided among the different classes.

From the figures given in the table below it appears that fractures through the great trochanter are twice as common as fractures through the neck, and that there is no difference between the two classes as regards the period of life at which they occur. They are both injuries which occur in patients in whom the changes of old age are present. Atrophy of the bone is no doubt one of the factors predisposing to the injury, for in some of the younger members of the series the patients have had such diseases as tabes dorsalis or hemiplegia, in which atrophy of the bone is known to occur. I think, however, that weakened muscles and a lengthened period of muscle reaction, both of which are present in old age, play some part in predisposing patients to these fractures.

| TYPE OF FRACTURE | MALES | FEMALES | TOTAL |
|--|-------|---------|-------|
| Fractures through the neck | 27 | 84 | 111* |
| Fractures through the great trochanter .. | 93 | 114 | 207* |
| Fractures below the great trochanter | 14 | 9 | 23 |

* Average age of the 111 patients 69.2 years. Youngest 53, oldest 89.
 " " " 20.7 " 69.4 " " 32 " 84.

Among patients with fractures through the great trochanter the sexes are almost equally represented, but among patients with fractures through the neck there are three women to every man. I do not know why there is

this inequality of the sexes, and have no suggestion to make. It may be that the greater width of the pelvis in women predisposes them to fracture of the neck, but I cannot see in what way it plays its part.

I do not propose to consider at length the physical signs by which fractures of the neck can be differentiated from those through the great trochanter. The diagnosis can generally, but not always, be correctly made; but as a radiograph gives so much more information than the most careful clinical examination, the clinical diagnosis is of little more than academic interest. I would, however, stress the points that neither the age of the patient nor the degree of shortening and external rotation present is in any sense a reliable factor in making the diagnosis.

TREATMENT.

1. Treatment of Fractures of the Neck.—When treating fractures of any of the long bones there are always four steps to be taken: (*a*) To reduce the displacement; (*b*) To bring the ends of the bone into contact; (*c*) To retain them in contact till bony union has occurred; (*d*) To restore the normal function of the limb. Our experience of fractures elsewhere in the body teaches us that if we are successful in taking those four steps we can confidently predict a good result from our treatment. Bad results of fractures of the upper end of the femur have been so common in the past that many fantastic theories have been advanced to account for and excuse such results. It was, for example, urged by Sir Astley Cooper, and has been repeated many times since, that the presence of synovial fluid from the hip-joint interfered with union of fractures of the neck; we know, however, that fractures into other joints give good results if the four steps above mentioned are taken. It has also been claimed that the blood-supply of the upper fragment is too poor to allow of bony union, but our knowledge of bone-grafts alone would be enough to show the inadequacy of this claim, even if it were true, which it probably is not.

The reason why fractures of the neck of the femur so frequently fail to unite by bone is that it has been found to be so difficult to devise a method by which the second and third of the above-mentioned steps can be secured. The upper fragment is a small piece of bone to which no muscles are attached, and the ball-and-socket joint immediately above allows it the freest movement. The lower fragment is, in effect, the whole lower limb, and the two points that we have to bring and retain in contact are deeply embedded in muscles which are in constant action whenever the patient moves the lower part of the trunk. A suspiciously large number of methods have been suggested for overcoming the difficulties that are thus made apparent; but while some of them have been successful in a small percentage of cases, the best method is that described by Whitman. Briefly stated, his method is to place the patient under an anæsthetic, to rotate the limb inwards, extend it in the direction of its long axis, abduct it as far as it will go, and, while the limb is maintained in that position, apply a plaster-of-Paris spica from the toes to above the pelvis. It is necessary to include the foot up to the toes to prevent the limb rotating inside the plaster and to carry it well above the pelvis to prevent tilting of the pelvis. We have found it better

to put on a double spica as shown in *Fig. 162*, since the surest method of fixing the pelvis is to abduct the other limb.

Fig. 163 shows a fracture of the neck of the femur, *Fig. 164* shows the same fracture in plaster after being treated in that way, and *Fig. 165* shows the result twelve months later. It is apparent that while the contact of the fragments was good enough to secure bony union, the reduction of the displacement was not quite perfect and there is some resulting deformity. The deformity, however, is slight, and the patient walks on a strong limb with a scarcely perceptible limp. It is always necessary to check the position by taking a radiograph through the plaster, and it not infrequently happens that two or more attempts have to be made before a good enough position is obtained.

The apposition of fragments in these cases is seldom as good as we could wish, and the splint must therefore be worn for a much longer time than in



FIG. 162.—Securing bony contact and union by the double spica bandage.



FIG. 163.—Fracture of the neck of the femur.



FIG. 164.—The same case as *Fig. 163* after application of plaster-of-Paris.

fractures with good apposition. The plaster can be removed in three months and the patient allowed to walk, although it is generally advisable to let him have a well-fitting caliper for a further period of three months. During this time the restoration of the function of the limb can, of course, be hastened by massage and radiant heat to the hip region. I would here refer to a

tiresome complication, namely, stiffness of the knee of the affected limb : this stiffness is much greater than that of the sound limb, although both knees have been in plaster for the same length of time. It is, I think, due to traumatic synovitis of the knee which is so often caused at the same time as the fracture.

This is a method of treatment which demands great care and perseverance on the part of the surgeon, even greater care and skill on the part of the nurses, and patience and long-suffering of a high degree on the part of the patient. In the younger patients up to 60 or 65 it can generally be carried out, but it is usually impossible in those over 70. In

FIG. 165.—The same case as Fig. 164 twelve months later.

such elderly patients it is generally best to be content with something less than bony union, and, if they are treated by the method to be subsequently described for fractures through the great trochanter, a fibrous union can generally be obtained that will enable them to get about, although there will always be a painful and crippled limb.

Fig. 166 shows a fracture of the neck treated in this way, and it will be seen that there is no bony union and considerable deformity. That patient, however, although a feeble old lady, was able to walk well without a stick and with but little pain.

2. Treatment of Fractures through the Great Trochanter.—The treatment of these fractures is not so difficult as those of the neck. Because the ends of the bone are driven together and not away from one another, bony union practically always occurs even if no treatment be adopted at all. But in such cases, although the union is firm, the coxa vara and external rotation are causes of considerable crippling.



FIG. 166.—Fracture of the neck of the femur treated without plaster, showing lack of bony union and considerable deformity.

The deformity must therefore be reduced, and an anæsthetic is generally necessary. If the fracture has impacted, and remained impacted, the fragments must be disimpacted, and in doing this it is important that the lesser trochanter should not be split off the shaft. It is almost surprising to find how easily they disimpact if the attempt is made within a day or so of the fracture and the limb is axially extended, rotated inwards, and widely abducted. It is in this position that the limb must be fixed; but in these cases it is never necessary to use a plaster-of-Paris splint. The broken surfaces are so broad, and the upper fragment is so much larger than in fractures of the neck, that bony union in good position can always be obtained by an apparatus such as that shown in Fig. 167. In order to maintain the abduction both legs must be slung, and in order to enable nursing and other movements to be made without disturbing the fragments the limbs must be balanced by

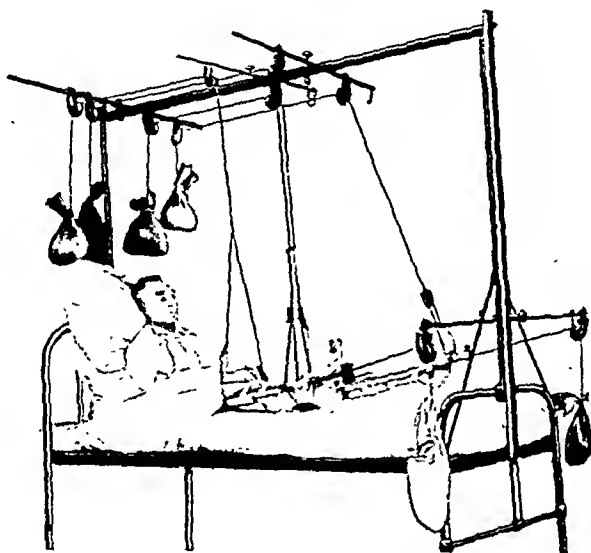


FIG. 167.—Apparatus for treatment of fractures through the great trochanter.

counterpoised weights. The limb is axially extended by a Buck's stirrup carrying, at first, a weight of about 15 lb. on the injured side and 7 lb. on the sound side, and the limb is supported on a Thomas or Hodgen frame with strips of Bavarian flannel to make a trough. The weight on the injured leg may be safely reduced by 1 lb. a week, and if this be done the restoration of function of the limb after removal of the splint is more rapidly effected. With the legs widely abducted and the patient propped in a semi-sitting position it is easy to correct the external rotation: flexion of the hip relaxes the psoas muscle, which is especially important in those cases where the lesser trochanter has been detached from the shaft. It is essential that the correction in these cases should be checked by radiographs taken with the patient in bed, and it is advisable to repeat these throughout the treatment to detect

any alteration that has occurred in the position of the fragments. *Fig. 168* shows an impacted fracture, and it will be noticed that the shaft below the lesser trochanter is split, but the fracture is incomplete and the lesser trochanter remains in its normal position. *Fig. 169* shows that fracture disimpacted and slung in the abducted position, and it can be seen that disimpaction has been accomplished without breaking off the lesser trochanter. The importance of this can be seen from *Fig. 170*, which shows the end-result of one of these fractures in which the main fragments are joined in

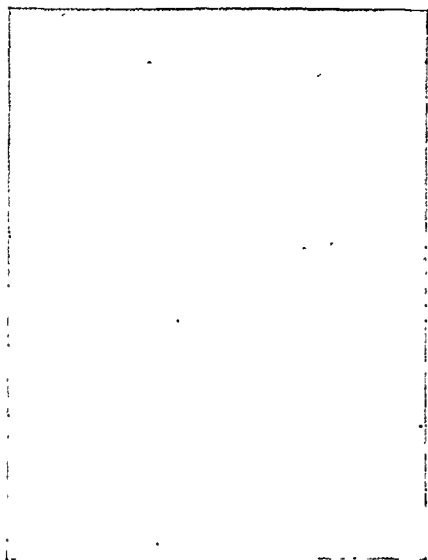


FIG. 168.—Impacted fracture through the great trochanter.



FIG. 170.—End-result of a fracture through the great trochanter, showing good union of the main fragments but displacement of the lesser trochanter.



FIG. 169.—Same case as *Fig. 168* after disimpaction.

good position but the lesser trochanter has been drawn upwards and inwards, where it is fixed by a mass of callus that will later become bone. Such a position results in considerable interference with the action of the psoas and instability of the hip-joint.

While the patient remains in this apparatus, constant and careful supervision is needed, and the nurses must thoroughly appreciate the principles that are involved. If it be remembered that the weights are so adjusted that by their pull they are holding the broken ends of the bone in the position in which

we wish them to join, it is clear that a momentary relaxation of the tension on the cords will break down in the early and distort in the later days the bone-forming material. Far too many bad results are due to the nurse who thoughtlessly lifts a weight for a few minutes to make easier a nursing duty, or to a stirrup being allowed to slip because it is not renewed soon enough. The stirrup on the injured limb nearly always needs to be renewed in course of treatment, and it is important that the extension on the limb should not be relaxed in the slightest while it is being done.

The treatment is more easily carried out satisfactorily if a fracture bed is available. Fracture beds as a rule cost about £20, but *Fig. 167* shows one which we had built to a home-made design and costs only £6. There are four crossbars 4 ft. long on each bed, and the spring mattress is made in eight sections and built of aluminium strips carried on steel spring to give rigidity. The hair overlay is in six sections, and the sections are easily removed without

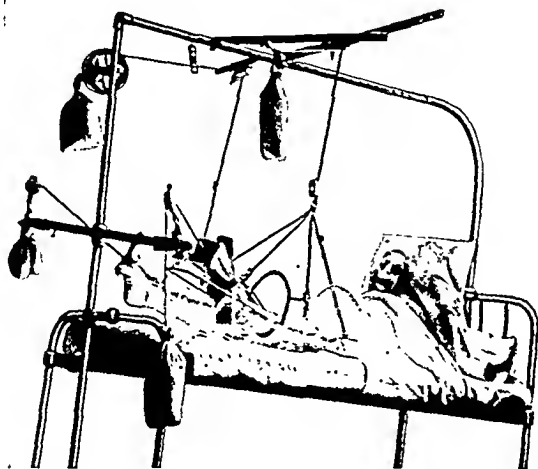


FIG. 171.—Improvised extension apparatus for treatment of fractures through the great trochanter.

altering the patient's position. If a fracture bed cannot be obtained, any carpenter or fitter can quickly build a superstructure from which the patient can be slung. *Fig. 171* shows such a structure made by the hospital fitter out of pieces of gas-pipe, and although it looks like a Heath Robinson picture it is quite efficient and still in use at the Hospital.

Extension, in the apparatus, should be maintained for about eight to ten weeks, and at the end of that time it may be removed and the patient got out of bed and encouraged to move the limb. A pair of crutches should be provided for the first week or two, and the restoration of function is materially aided by massage and radiant heat to the hip region. I have found that the period of invalidism is shortened if the patient be got out of bed immediately after the splint has been removed, instead of lying in bed for a few days. As in fractures of the neck, the knee of the injured limb often

causes the patient more pain and trouble than the hip, and care should be given to that joint.

In none of the patients of this series has open operation been performed for a recent fracture. In those through the great trochanter, bony union in good position can, I believe, always be obtained without operation. In fracture of the neck, the hold obtained on the upper fragment by a peg or screw is so precarious that it is doubtful whether the operation would materially shorten the period of immobilization, and unless it does that it is difficult to see what advantage is to be gained by operation. Operation might be necessary if apposition of the fragments were prevented by interposed tissue; but I have never had a case in which crepitus could not be obtained when the patient was under an anæsthetic, so I do not think that it is common for there to be any structure between the fragments keeping them apart.

Before leaving treatment I should like to make a short reference to the *first-aid treatment* of these injuries. Everybody now condemns the Liston splint, but we still continue to receive patients at hospital with a long wooden splint applied in such a way that it is a gross libel to couple Liston's name with it. As used, the long wooden splint does not provide any extension, and while it materially adds to the patient's discomfort it certainly does no good and may at times do harm.

Quite as much to be condemned is the practice of putting the injured leg between sand-bags. If the sand-bags are so applied as to immobilize the limb, they only ensure that every movement of the patient's body causes a movement at the seat of fracture, and I have often seen a patient sigh with relief when the sand-bags were removed. The best first-aid treatment is a Thomas knee splint applied with an axial extension. This can well be worn for forty-eight hours, and if the patient has to be moved to hospital the splint should be slung from the roof of the conveyance as first suggested by Hodgkin in the American Civil War. If no Thomas splint be available, a simple weight extension over the end of the bed or stretcher gives comfort to the patient and ensures that only the minimum of damage is done.

RESULTS.

Fractures of the upper end of the femur have always been notorious for causing a high mortality among the patients suffering from them. When we remember that the average age of patients in this series was over 69 years, it is clear that many of them were already tottering along the path that leads to the grave, and the false step that caused the fracture was but a jolt that hastened little, if at all, their arrival at the end of the journey.

Of the 111 patients with fractures of the neck of the femur, 31 died without leaving hospital. Of the 207 patients with fracture through the great trochanter, 51 died; and of the 23 subtrochanteric fractures, 6 died. These are high figures, but it must be remembered that they are those of patients admitted to a Poor Law hospital, and there are included among the deaths many who had recovered enough from their injury to enable them to leave their beds, but who were destitute and had no home in which they

could lead the lives of invalids. For example, of the 15 patients who died in the two years ending April 1 last, 8 lived over six months, and 2 for over a year after their injuries. The remaining 7 all died within thirty days of their injuries, and this latter figure gives a truer picture of the mortality due primarily to these fractures.

I have not found it possible to classify from the notes at my disposal the results as regards the ultimate function of the injured limb. The disability resulting from fractures of the neck has been much greater than that resulting from fractures through the great trochanter, but even among the former there have been many who have recovered function good enough to enable them to return to their former employment.

CONCLUSIONS.

1. Fractures of the neck of the femur are due to an axial twist of the lower limb.

2. Fractures through the great trochanter are caused by indirect violence which thrusts the head of the femur downwards while the limb is adducted and rotated outwards, tending to lessen the angle the neck makes with the shaft.

3. Direct blows on the great trochanter do not fracture the femur, but, if the force be great enough, cause fractures through the acetabulum.

4. There is no difference in the ages at which fractures through the neck and fractures through the great trochanter occur. The average age of 111 patients with the former was 69 years 2 months, and of 207 with the latter was 69 years 4 months.

5. Fractures through the neck are best treated by a Whitman's plaster, but age and debility often prevent this.

6. Fracture through the great trochanter, if impacted, should be disimpacted, and in all cases treated by suspension and extension with the limb in an abducted position.

A CASE OF NEUROCYTOMA OF THE ADRENAL.

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THE following case appears to us sufficiently uncommon to be worth placing on record.

The patient, a little girl, age $3\frac{1}{2}$, was admitted to the Miller Hospital on Sept. 10, 1926, having been ill for a week with headache and abdominal pain. There had been no diarrhoea or vomiting, but the child was said to have had several fits. On examination she appeared thin and very pale; the temperature was 101.8° , the pulse 140. The abdomen was distended, some free fluid being present, and was 'doughy' to the touch; some indefinite masses were felt in the region of the umbilicus and also below the right costal margin. The latter were thought to be thickened masses of omentum and matted coils of intestine, the clinical picture as a whole suggesting a condition of tuberculous peritonitis. The blood-count was as follows: Total red cells, 3,940,000; total white cells, 4900; hæmoglobin, 50 per cent; colour index, 0.7. Differential leucocyte count: polymorphonuclears, 42 per cent; large and small lymphocytes, 48 per cent; hyalines, 8 per cent; eosinophils, 2 per cent; mast cells, 0 per cent.

During the next few days the temperature varied between 98° and 103° , and the pulse-rate averaged 150. The child complained alternately of abdominal pain and headache, and her increasing irritability was thought to be heralding the onset of tuberculous meningitis. At the end of three weeks, however, no cerebral manifestations had appeared and the ascites had markedly increased. There being no abnormal physical signs in the chest and no clinical evidence of general dissemination of disease, it was thought that the case was one of abdominal tuberculosis of the ascitic variety in which benefit might result from opening the abdomen. Mr. Cecil Joll, who was asked to see the patient in consultation, agreed with this view, and laparotomy was performed by Mr. Kelman on Sept. 30. The peritoneal cavity was found to be full of dark blood-stained fluid, which was slowly evacuated. Enlarged glands were found in the mesentery; the great omentum was much matted but was not hard; nodular masses were found scattered over the parietal peritoneum in the epigastric region. Some free hæmorrhage was seen to be occurring from the region of the great omentum; this was apparently from a small vein and was dealt with at once, the abdomen being closed as soon as possible owing to the patient becoming collapsed, a small portion of one of the nodular masses being quickly excised for examination. The child's condition became progressively weaker, and she died on Oct. 15, a fortnight after the operation.

Post-mortem Examination.—The body was emaciated, the abdomen being considerably distended. After removal of about four pints of deeply blood-stained fluid, attention was arrested by numerous masses of a greyish or pinkish-white colour scattered everywhere throughout the abdominal cavity. The omentum was represented by agglomerated portions of the above, the mesenteric glands by larger nodules soft and friable in character, and the retroperitoneal glands by still larger deposits. Both flanks contained quantities of tumour tissue which on the right side invaded the under surface of the liver and extended as a continuous growth into the right iliac fossa. The spleen was moderately enlarged, but was otherwise normal in appearance. The kidneys, situated behind the tumour tissue, were unaffected; the left suprarenal body lay in the usual position and was intact, but on the right side the kidney was capped by a huge mass of growth in which no suprarenal structure could be detected. A few small nodules were attached to the surface of the uterus; the ovaries were normal. The stomach and intestines were normal. None of the viscera showed invasion by the growth except the liver, which, as already stated, was penetrated to the extent of a few centimetres from the surface. Whereas on the under surface of the diaphragm only a few small nodules were seen, from the upper surface, especially on the left side, large masses projected into the thoracic cavity. The left lung was compressed by these and by about a pint of puriform fluid, so that only the extreme apex was aerated; the right lung was compressed in much less degree by the growth and by a few ounces of clear yellowish fluid; there was no actual invasion of the lung tissue itself. The heart and pericardium were normal, but the mediastinal glands were replaced by large nodules of growth. Outside the thoracic and abdominal cavities no trace of growth was found either in the glands or elsewhere. The brain was normal.

Microscopical Examination.—The structure of the tumour was fairly constant. The constituent round, oval, or spindle-shaped cells varied in size, their diameter being from once to twice that of a polymorphonuclear leucocyte. They lay singly, in lines of one to half a dozen cells, or in groups of two or three to twenty or thirty, and occasionally in large groups and columns containing as many as several hundred cells. In some cases the individual cell outlines could be distinguished, in others the cytoplasm seemed common to a number of nuclei. The nuclei themselves were round or oval, sometimes indented or reniform in shape, and contained both coarse and fine points of chromatic material and from one to three large nucleoli. The cytoplasm, owing to its small amount and to its basophilic reaction when stained with iron alum hæmatoxylin and eosin, was not easily recognized with low powers of the microscope. Degenerative changes were not frequently seen. Mitotic figures were fairly common—in most fields one or two could be distinguished under the $\frac{1}{6}$ objective. The cell groups were separated by numerous areas in which ran a number of thin-walled vessels consisting mainly of an endothelial lining supported by a delicate connective-tissue layer; other larger spaces were lined by only a single layer of endothelium, and were frequently filled with masses of tumour elements. Apart from the vessels, the intercellular spaces were occupied by a finely fibrillated ground substance (*Fig. 172*), and in favourable circumstances the tumour-cell cytoplasm was seen to be prolonged



FIG. 172.—Showing tumour cells and fibrillated ground substance. Microphotograph (low power).

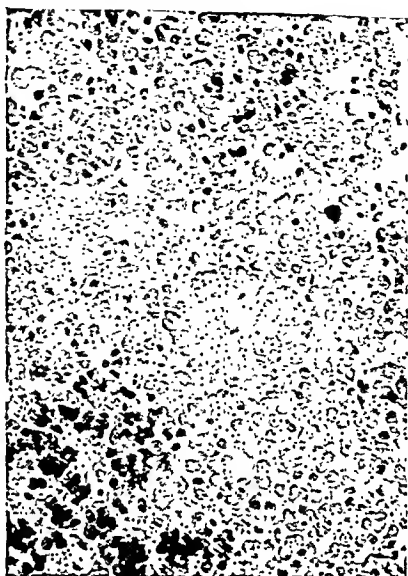


FIG. 173.—Showing portion of tumour from which the coloured drawing was made to illustrate rosette with central radial striation. Microphotograph (high power).

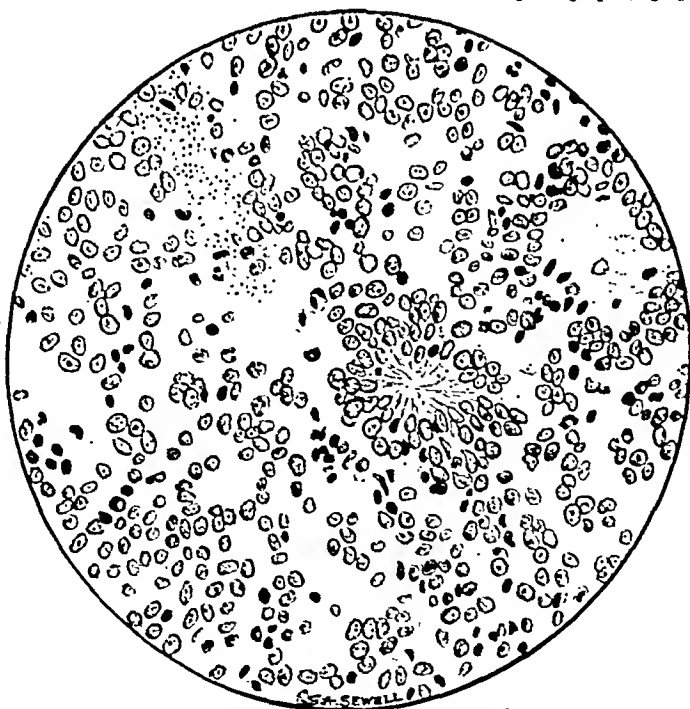


FIG. 174.—Coloured drawing to illustrate details of Fig. 173. ($\times 270$.)

into definite processes which were connected with the fibrils. The fibrils stained pale pink with eosin, brownish in van Gieson sections, and a reddish green (quite distinct from the brilliant green of collagen fibres) in hæmatoxylin-fuchsin-ponceau-light-green preparations. With Foot's method¹ for reticulum fibres a negative result was obtained, and specific stains for neuroglia also failed to colour the fibrils. In many areas the growth was freely infiltrated by polymorphonuclear leucocytes, and hæmorrhages were not infrequent.

While from the above description it will be seen that for the most part the arrangement of the tumour cells was more or less haphazard, in a few places a more positive arrangement was encountered. After careful searching through a number of sections, certain areas were noted in which the nuclei of a small group of cells were arranged peripherally while the cytoplasmic processes were directed centrally and were sometimes distinctly fibrillated with resulting 'rosette' formation; very rarely a small cavity formed the centre (*Figs. 173, 174*).



FIG. 175.—Showing liver invaded by growth.
Microphotograph (low power).

The spread of the tumour was mainly along the lymphatic channels, and in some of the lymph glands in an early stage of invasion numbers of malignant cells could be seen blocking the lymph sinuses. The larger spaces filled with neoplastic elements, in the older parts of the growth, appeared to be lymphatic channels and not blood-vessels. In the liver there was definite deposition of fibrous tissue between the advancing edge of the tumour and the compressed and atrophied liver cells

(*Fig. 175*), but beyond this limit groups of malignant cells could be seen in the hepatic sinusoids between the columns of liver cells.

DISCUSSION.

In discussing the nature of this tumour a point of some importance to be decided is whether the right suprarenal body, of which no trace was found at the autopsy, was merely replaced by growth or was actually its site of origin. The latter alternative appears to us on the whole more probable. Before giving our conclusions we think it may be of interest to give the following brief résumé of the literature available on the subject of adrenal tumours.

Pepper⁵ in 1901 described a growth of this gland which he considered to be a lymphosarcoma, becoming evident soon after birth and giving rise to diffuse infiltration of the liver. In the type of adrenal 'sarcoma' described by Hutchison³ metastases occur typically in the cranial and other bones as

well as in the liver. Frew² showed that this difference in distribution of the metastases depends on the different lymphatic drainage on the two sides; from the left adrenal gland secondary deposits are found in the liver, ribs, and cranial bones, and also in the thoracic duct and some of its tributaries, while on the right side the growth spreads at the bare area to the surface of the liver, and to the kidney, pleura, and lung, thus tending to remain localized in the abdomen and thorax. Wright⁶ gives adequate reasons for considering these growths as neurocytomata arising from the medullary cells of the adrenal, and Masson⁴ also describes them as of sympathetic origin. Although formation of 'rosettes' is typical of the neurocytomata, Masson states that they are found most readily in the less malignant neoplasms: in their absence the tumour may be indistinguishable from lymphoblastic sarcoma, a common diagnosis in these cases before their true nature was realized.

In the present case we were led to class the growth as a neurocytoma by reason of: (1) The nuclear characteristics; (2) The scanty cytoplasm; (3) The separation of masses of cells by bundles of fibrils not staining like collagen, neuroglia, or reticulum, and the obvious origin in some areas of these fibrils from spindle-shaped tumour cells; (4) The attempts at 'rosette' formation. This diagnosis was not, however, made without considerable deliberation. At first, indeed, we were inclined to regard the tumour as mesodermal in origin, and it was only after the application of special staining methods and the discovery, by a careful search through a number of sections, of occasional 'rosettes' that the true nature of the growth became obvious. A study of the literature shows that neurocytoma is a well-recognized entity. That the condition is not so very uncommon is suggested by Masson's statement that he has personally met with five cases within three years. Nevertheless, it seems probable that a number of the more malignant (and less differentiated) examples are wrongly diagnosed, for in a case like the one under discussion an ordinarily careful routine examination of a few sections only may well fail to reveal the characteristic cytological grouping which places the diagnosis beyond doubt, and even if occasional imperfectly-formed 'rosettes' are found, these may be taken for a mere chance arrangement of the tumour cells.

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TYPES OF GALL-BLADDER INFECTION: A STUDY OF 100 OPERATED CASES.*

By C. F. W. ILLINGWORTH, EDINBURGH.

THE frequent occurrence of bacterial infection in diseased gall-bladders has long been recognized, and its importance as one factor in the production of gall-stones is now hardly in doubt—indeed, some go so far as to assert that it is the primary or even the sole cause of nearly all stones in this situation—but the relative frequency of different types of organisms, their original foci, and their routes of approach to the gall-bladder are still subjects for discussion.

Bacterial investigations of diseased gall-bladders have in the past been limited for the most part to smear and culture examinations of bile obtained at operation, and these in the hands of different workers have yielded results which vary greatly both in the frequency and in the nature of the infecting organisms isolated. Thus Hartmann¹ found an infection of the bile to be present in a considerable majority of cases, whereas Johnson² and Drennan³ found it to occur in only 32 per cent and 19 per cent respectively. In the experience of all these workers *Bacillus coli* was the organism of most frequent occurrence, whereas in Huntenueller's⁴ series staphylococci headed the list and were found twice as often as the coliform organism. All are agreed, however, that the bile of even grossly diseased gall-bladders is sterile in quite a large proportion of cases, and Rosenow⁵ has shown that it is only by making cultures from the gall-bladder wall itself that an accurate idea of the infection present may be obtained. In his experience the organism most frequently found by such an examination is a streptococcus.

There are several routes by which organisms from other foci in the body may reach the biliary tract and the gall-bladder. The earliest conception, that of an ascending infection from the duodenum along the common and cystic ducts, is not now generally supported as a mode of origin of cholecystitis, except perhaps in rare cases. Whilst it seems probable that infection against the slow bile current *may* take place, its occurrence is unlikely, especially as the duodenal content, even in known cases of cholecystitis, contains pathogenic organisms in only a small proportion of cases.

There remain, therefore, three possible routes to the gall-bladder: (1) The organisms may reach the liver either in the systemic blood-stream or by the portal circulation and be excreted in the bile. (2) Having reached the liver they may set up a localized, low-grade hepatitis, and spread thence to the gall-bladder by way of the lymphatics (Graham⁶). Similar lymphatic extension might also occur from neighbouring viscera—stomach, duodenum, pancreas, and possibly appendix. (3) They may pass in the systemic blood-

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stream from some distant focus direct to the gall-bladder, there to set up an intramural infection, and later to infect the bile (Rosenow⁵).

A clearer knowledge of the etiology of cholecystitis would seem to be of some importance for the treatment or even the prevention of this disease, and it is with this object that the investigation recorded below has been carried out. It consists of a bacteriological examination of a series of gall-bladders operated upon by Professor Wilkie. By his courtesy I have been able, in 100 cases, to take portions of the gall-bladder wall in addition to samples of the bile, or other fluid content, for culture. Wherever possible the cystic lymph gland has also been identified and dissected off the cystic duct for a like purpose, and in many cases stones removed have been similarly examined.

In carrying out this work I have endeavoured especially to answer the following questions:—

1. Is the gall-bladder wall or the bile more frequently the site of a demonstrable infection, and what organisms are most commonly found in these two sites?

2. Is any one organism more constantly present in the early stages of the disease and therefore likely to be an active agent in its production?

3. Is there any evidence that any one of the routes of approach referred to above forms the usual path?

METHOD OF EXAMINATION OF TISSUES REMOVED AT OPERATION.

The medium used for culture of the tissues removed has been the glucose-brain-broth recommended by Rosenow.⁷ It is made by adding fragments (1 grm.) of brain tissue to tall tubes of ordinary broth, sterilizing in the autoclave, and adding glucose to make a 0.2 per cent solution. The advantage claimed for this medium is that it gives a gradient of oxygen pressure, from complete aerobiosis at the surface to relatively anaerobic conditions near the bottom of the tube, and it seems especially suitable for culture of the rather slow-growing organisms occurring in cholecystitis. To exclude contamination as far as possible, the specimen—gall-bladder, bile, or other tissue—should be dealt with immediately after its surgical removal, since any delay even in the relatively sterile air of an operating room naturally increases the risk.

Collection of the bile by means of a syringe or a sterile swab presents little difficulty; but the gall-bladder, exposed to manipulation and to contact with the wound surfaces, requires greater care if contamination is to be avoided, and the portion to be incubated should be washed thoroughly in several changes of saline before it is transferred to the culture medium. In addition, in some of the more recent cases a further safeguard has been adopted, and the tissue, removed and washed as before, has been sterilized on its surface by exposure to ultra-violet rays. It was found that if the portion of tissue was picked up in fine-pointed forceps and exposed at a distance of 5 in. to the rays of a 7-ampère tungsten arc, an exposure of one minute sufficed to destroy even gross surface contamination, and as the rays

have little penetrative power, any organisms present deeper in the tissue are unaffected.

Table I.—RESULTS OF CULTURES FROM 100 GALL-BLADDERS.

| Tissue | No. EXAMINED | No. INFECTED | STREPTOCOCCI | COLIFORMS | STREPTOCOCCI AND COLIFORMS | <i>Staph. aureus</i> | <i>Staph. albus</i> | STERILE UNDEVELOPED |
|----------------------|-----------------|-----------------|--------------|-----------|-------------------------------|----------------------|---------------------|------------------------|
| Gall-bladder wall .. | 100 | 62 | 34 | 17 | 5 | 1 | 5 | 0 |
| Bile .. | 100 | 40 | 16 | 20 | 1 | 1 | 2 | 0 |
| Crushed stone .. | 23 | 7 | 2 | 3 | 0 | 1 | 1 | 0 |
| Cystic gland .. | 15 | 6 | 3 | 2 | 0 | 0 | 0 | 1 |

Table I shows the incidence of infection found in the various sites, and also the nature of the organisms present. It will be seen that cultures of the gall-bladder wall showed the occurrence of an infection in a large percentage of cases (62) as compared with the bile, which in the majority of cases was sterile. The nature of the infecting organisms also differed very considerably in the two sites. For streptococci, which predominated in the gall-bladder wall, were often found to be confined to this situation, and the gall-bladders thus infected in many cases contained sterile bile. Infection of the bile, on the other hand, was, in exactly half the total number infected, due to coli-form organisms, and in these cases the gall-bladder was generally found to give a growth of the same nature.

Mixed infection, as will be seen, occurred in but a few instances, and *Staphylococci aureus* and *albus* were also rather infrequent. *Staph. aureus* occurred on three occasions—once in the gall-bladder wall, once in the bile, and once in the cultures from a crushed stone. My attention was recently drawn to the observation of R. R. Graham,⁸ that the isolation of this organism is frequently associated with a clinical history of mucous colitis, and it is therefore interesting to note that in the three cases here recorded this was not present—indeed, two of the patients had a definite history of chronic constipation.

Examination of crushed gall-stones proved rather disappointing. Infection was present in only 7 out of the 23 examined, and in 4 of these contamination from the bile, which yielded the same organisms, could not be absolutely excluded. Cultures from the cystic gland also afforded little information, and in every case but one gave a growth similar to that of the gall-bladder or bile.

With regard to the clinical recognition, at operation, of cases likely to be found infected, the general impression gained was that a positive culture from the gall-bladder was more likely to be obtained in a case where the wall was thick and fleshy than where the changes were less marked. Infection of the bile, on the other hand, was more difficult to estimate from the naked-eye appearance. In some cases perfectly clear watery bile yielded a vigorous

growth on culture; yet in others, where the gall-bladder content was thick, turbid, and of almost stercoraceous appearance, no growth could be obtained.

CLASSIFICATION OF THE ORGANISMS ISOLATED.

All the coliform bacilli isolated were as a routine inoculated into tubes of lactose peptone and on to McConkey plates, and with one exception they showed the reactions of 'typical *B. coli*'. In the exceptional case, where lactose fermentation failed to occur, an acid reaction took place with saccharose, and the identity of the organism was established as 'atypical *B. coli*'. The interest of this series lies in the fact that the typhoid bacillus was never isolated, although at least three of the patients had a previous history of this fever. This is in confirmation of the experience of Judd,⁹ who failed to isolate this organism from 21 patients who had previously suffered from the disease.

Of the streptococci isolated, the majority had many characters in common. They grew rather slowly, and in broth after twenty-four hours or even forty-eight hours only a faint diffuse opacity might be evident. Films showed the cocci chiefly in short chains, but also often in pairs, and usually of rather small size. On agar and blood-agar the growth was also slow, and the colonies, minute, discrete, and colourless, but often in great numbers, even after forty-eight hours could sometimes be readily observed with the aid of only a hand lens. In films from solid media diplococci were rather more evident, and in some cases tended to form clumps.

In the 32 cases where subcultures were made on to blood-agar, hæmolyzing streptococci occurred only 3 times; green discoloration of the medium was observed in 3 cases, and in the remaining 26 no hæmolysis took place.

In 21 cases the streptococci were typed according to Holman's classification,¹⁰ and it will be seen that in spite of their superficial similarities wide differences of biochemical reaction existed.

Table II.—CLASSIFICATION OF STREPTOCOCCI FROM 21 GALL-BLADDERS.

| NO. OF CASES | HÆMOLYTIC | LACTOSE | MANNITE | SALICIN | CLASSIFICATION |
|--------------|-----------|---------|---------|---------|-------------------------------|
| 2 | No | Acid | Acid | Acid | <i>Str. faecalis</i> |
| 4 | " | " | " | No acid | <i>Str. non-hæmolyticus 1</i> |
| 1 | " | " | No acid | Acid | <i>Str. mitis</i> |
| 7 | " | " | " | No acid | <i>Str. salivarius</i> |
| 5 | " | No acid | " | " | <i>Str. ignavus</i> |
| 1 | Yes | Acid | " | " | <i>Str. anginosus</i> |
| 1 | " | No acid | " | Acid | <i>Str. equi</i> |

Growth of the streptococci in the peptone water used for sugar media is apt to be rather uncertain, and accordingly it was customary to inoculate a large quantity—1 c.c.—of the broth culture into each tube; and in cases where even then growth was doubtful after three or four days' incubation control tubes of agar were then inoculated from the sugar media to determine this point. Absence of inulin fermentation was relied upon to exclude the pneumococcus, which did not occur in this series.

FREQUENCY AND TYPE OF INFECTION IN VARIOUS STAGES OF CHOLECYSTITIS.

In *Table III* all the cases examined have been grouped according to the stage of disease present. As many classifications of affections of the gall-bladder seem to be of a needlessly artificial character, the various grades of disease merging into each other, I have attempted to simplify the grouping as far as possible, and the primary groups have been limited to three, depending upon the naked-eye characteristics of the gall-bladder wall rather than on other factors such as the presence or absence of stones. A fourth group has been added, consisting of those cases in which to the naked eye a localized or diffuse deposit of lipid material was visible in the mucosa; all these cases showed distinct evidence of chronic inflammatory changes, and they are therefore also included in *Group 2*.

Table III.—LOCATION OF INFECTION IN VARIOUS TYPES OF CHOLECYSTITIS.

| GROUP | NO. OF CASES | WALL INFECTED | CONTENT INFECTED |
|--|--------------|---------------|------------------|
| 1. <i>Acute cholecystitis</i> .. | 12 | 10 | 10 |
| 'Empyema' .. | 8 | 8 | 8 |
| Early obstruction .. | 4 | 2 | 2 |
| 2. <i>Chronic cholecystitis</i> .. | 65 | 41 | 25 |
| With stones .. | 52 | 33 | 21 |
| Without stones .. | 10 | 6 | 3 |
| Hydrops .. | 3 | 2 | 1 |
| 3. <i>Early cholecystitis (chronic)</i> .. | 23 | 11 | 5 |
| With stones .. | 7 | 3 | 3 |
| Without stones .. | 16 | 8 | 2 |
| 4. <i>Cholesterosis</i> | 6 | 4 | 2 |

Group 1 : Acute Cholecystitis.—The symptoms arising from acute cholecystitis are rarely sufficiently grave to require an immediate operation unless or until the cystic duct has become obstructed, and it therefore happens that this had occurred in all the cases in this group.

Following obstruction of the duct in 8 of these cases an empyema of the gall-bladder had developed, and it was tense, thick-walled, and acutely inflamed. As was to be expected, cultures showed the presence of organisms in each of these cases, in the wall as well as in the contained pus. Streptococci occurred 4 times and in 2 cases were hæmolytic; *B. coli* were present 3 times; and the two organisms were found together once.

In the remaining 4 cases of this group operation was performed early during the attack, and though the gall-bladders were obstructed, distended, and thick-walled, they contained comparatively clear bile and only a slight excess of mucus. Only two of these cases showed the presence of an infection, streptococcal in one and coliform in the other.

Group 2 : Chronic Cholecystitis.—This group includes the type of case most frequently seen at 'interval' operations, in which the gall-bladder shows

to the naked eye moderate or gross thickening of its walls, but no evidence of an acute infection. Stones were present in 52 uncomplicated cases of this group and absent in 10. In 3 a stone impacted in the cystic duct or in Hartmann's pouch had given rise to a slow distention—a hydrops—of the gall-bladder.

In this group, naturally, infection was considerably less frequent of occurrence than in the first, and was only found in 41 of the 65 cases. The most noteworthy feature was that in a large proportion of these a pure growth of streptococci was obtained in cultures of the wall, and that in many the organisms were found in this situation only, the bile being sterile. It is also of interest to note that such a purely intramural infection often occurred where stones were present in the gall-bladder, and indeed almost as frequently in the presence of stones as in their absence. (*See also Table V.*)

B. coli occurred in the bile in 13 cases; in the wall, in pure culture in 11 and along with streptococci in 3. *Staphylococcus albus* was found twice in the bile and thrice in the wall and *Staphylococcus aureus* was present once in each situation.

Group 3: Early Cholecystitis.—In this group are those cases, 23 in number, in which the pathological changes visible in the wall of the gall-bladder were relatively slight—loss of normal blue colour, a little thickening of the wall, and perhaps a small excess of subserous fat. Stones were present 7 times and were absent in 16. Here also the occurrence of an intramural infection was a notable feature. Streptococci were found in the wall on 6 occasions, *B. coli* twice, the two together once, and *Staphylococcus albus* twice. The bile in 2 cases contained streptococci (once the bile alone was thus infected and the wall was sterile), in 2 *B. coli*, and in the remainder proved sterile.

Group 4: Cholesterosis.—In 6 of the cases in *Group 2* there was visible in the mucosa some degree of lipid infiltration (cholesterosis), varying in extent from a patchy distribution over small areas to a fully developed 'strawberry' appearance. No case was encountered of cholesterosis without also definite inflammatory change, and in 4 cases stones were also present. Streptococci occurred in the wall of 3 and in the bile of 1, whilst *Staphylococcus aureus* was found in the wall of 1 case and in the bile from another.

INCIDENCE OF INFECTION IN DIFFERENT LAYERS OF GALL-BLADDER WALLS.

It has frequently been observed that even in grossly diseased gall-bladders the greater part, or in some cases even the whole, of the histological change is confined to the outer layers of the wall, and the stroma and epithelium of the mucosa are relatively healthy. This observation is important in relation to the etiology of the disease, and has been stressed especially by Graham as evidence that the infection may spread by lymphatic channels from the liver. In the hope that a similar localization of the infection might be demonstrated bacteriologically, the following method was carried out in 30 cases, separate portions of the mucosa and of the outer layers of the wall being incubated separately.

The gall-bladder, immediately after removal, was held on the stretch by four pairs of tissue forceps, and a small area of the outer part of the wall, peritoneum, and subserous and muscular coats was then dissected off the underlying mucosa, care being taken not to open into the lumen of the organ. The underlying mucosa was then also removed, and each portion, after thorough washing, was added to culture medium.

Table IV.—INCIDENCE OF INFECTION IN DIFFERENT LAYERS OF THE GALL-BLADDER WALL.

| | CASES |
|---|-------|
| Both layers sterile | 9 |
| Same organism from each layer (streptococci in 11, <i>B. coli</i> in 4) | 15 |
| Infection of mucosa alone (streptococci in 2, <i>B. coli</i> in 2) .. | 4 |
| Infection of outer layers alone (streptococci) | 1 |
| Streptococci in outer layers, <i>B. coli</i> in mucosa | 1 |
| Total | 30 |

It will be seen that in the majority of the 30 cases separate cultures of different layers of the wall yielded little further information. In 9 both layers were sterile, and in 15 the same organism was isolated from each. Consideration of the table would seem to show that in the remaining cases the mucosa shows a greater incidence of infection, but it happened that in two of the instances in which this was the finding the bile was similarly infected, and contamination from this source might have occurred.

In this short series, therefore, there has been found no evidence that one or other of the layers of the gall-bladder wall is more prone to infection.

Table V.—OCCURRENCE OF AN INTRAMURAL STREPTOCOCCAL INFECTION IN THE 88 INTERVAL CASES,

| NAKED-EYE APPEARANCE OF GALL-BLADDER | TOTAL NO. OF CASES | INTRAMURAL STREPTOCOCCAL INFECTION |
|---|--------------------|------------------------------------|
| <i>Stones present</i> | 62 | 13 |
| Chronic cholecystitis (including hydrops) | 55 | 13 |
| Early cholecystitis | 7 | 0 |
| <i>Stones absent</i> | 26 | 7 |
| Chronic cholecystitis | 10 | 2 |
| Early cholecystitis | 16 | 5 |

DISCUSSION.

The most interesting point which emerges from the study of this series of cases is the comparatively frequent occurrence of a purely intramural streptococcal infection. In Rosenow's opinion such a localization of the organisms is due to a direct blood-spread from distant foci such as the teeth or tonsils, and in support of it he has been able to demonstrate experimental cholecystitis following the intravenous injection of organisms of this type. Whether cholecystitis in man occurs in this way, or is due, as suggested by Graham, to spread of the infection by lymphatic channels, remains a moot point. The evidence given by this work does, however, tend strongly to

corroborate the present-day opinion that spread of the organisms via the bile, either from the liver or from below, is not the usual route, and indeed probably occurs only rarely, if at all.

It is difficult to correlate the presence of gall-stones, which were found in 13 out of 20 cases, with an infection entirely limited to the wall, and it seems likely that in these cases the infection had not at all times been so circumscribed. No doubt, during small acute exacerbations of the disease, infection spreads to the bile, which later, through its slight antiseptic power and by the continual fresh flow from the liver, once again becomes sterile.

In relation to diagnosis the investigation here recorded is of interest, as it affects the Meltzer-Lyon test, for, in view of the occurrence of uninfected bile in 60 per cent of cases it seems obvious that a negative bacteriological finding in this examination must be of no significance, and in fact it does not even exclude the presence of gross gall-bladder disease.

In regard to treatment of cholecystitis, the presence of active infection deep in the wall of the gall-bladder, as opposed to a catarrh of its mucosa, tends to diminish one's faith in those therapeutic measures which are directed solely to disinfection of the bile, and to emphasize the value of operative treatment. It would also suggest that, at any rate in the great majority of grosser lesions, drainage by cholecystostomy is insufficient to eradicate the disease and that cholecystectomy is the operation of choice.

In conclusion, I would like to express my great indebtedness to Professor D. P. D. Wilkie, who first suggested this research and has throughout been at considerable pains to render it possible.

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INCONTINENCE OF URINE OF RENAL ORIGIN.

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THE developmental anomaly here described and illustrated is doubtless rare in itself. It is manifested, however, by a very common symptom—*incontinence of urine*, and is accordingly of general interest and importance. The literature abundantly illustrates how often these cases have escaped diagnosis. This is the more to be regretted, as surgical intervention will in all cases relieve the unfortunate sufferers from an affliction which makes life a burden and shuts them off from all social activity. The only reference that can be found in the English literature is in an article by Milton in the *Lancet* of 1893. This author describes a case of his own and refers to a previous one of Lawson Tait's. These were almost certainly examples of *incontinence* due to an aberrant ureter, though they were not described as such.

Strictly speaking, the flow of urine from the urethra or vestibule from a ureter opening outside the bladder is improperly described as '*incontinence of urine*', a term generally restricted to pathological leakage from the bladder. The patients, however, always present themselves as cases of *incontinence* and are habitually treated as such, and it seems more convenient to deal with the subject under this head.

CASE REPORT.

Eileen K., age 6, admitted June 18, 1925.

HISTORY.—The mother noticed nothing abnormal for the first eighteen months. After that time she observed that the child's clothes were always wet. There was no nocturnal enuresis, but always in the morning a slight stain on the sheet. Urine was passed naturally in the morning and at intervals during the day—the usual amount at each evacuation being 4 oz. At first there was no offensive smell from the discharge, but this became a noticeable feature after the age of 3 years. The patient had been treated by means of atropine and belladonna given by the mouth, and later by instillations of silver nitrate and vaccines of *B. coli*, but without result. Sometimes for a day or two there would be practically no leakage, and then an increased amount would follow. The family history was unimportant.

ON EXAMINATION.—The patient was a bright, healthy-looking child. Neither kidney was palpable or tender, and there was no tenderness or dullness in the suprapubic region. The vulva was slightly reddened and very moist. Urine dripped away from the urethra in series of ten to fifteen drops; there would then be an interval of about thirty seconds and then another series of drops. The escaping fluid seemed to fill the vagina and then overflow from it. A small rubber catheter was passed, and it was noted that the point of the instrument appeared to be held up momentarily as if by a fold of mucous membrane just before it entered the bladder. Two ounces of urine were withdrawn, and this on examination contained a few pus cells and a large number of *B. coli*.

Cystoscopic Examination.—The bladder mucosa was normal in appearance. The right ureteric orifice was similar in appearance to the left, but different in

position. It lay more medially and nearer to the bladder neck. The efflux from both ureters was forcible and occurred at intervals of twenty seconds. The internal sphincter appeared to offer the normal resistance to the passage of the instrument.

Ten c.c. of indigo-carmin solution had been injected into the gluteal muscles immediately before the examination. The dye appeared in strong stream and good concentration from both sides fourteen minutes from the time of injection. The cystoscope was withdrawn and the bladder emptied; the solution filling the bladder was then quite blue. The drip from the urethra recommenced, but it was absolutely clear. Testing it by absorption with filter paper proved that there was no trace of dye. A catheter was then inserted into the bladder and deep-blue urine withdrawn, while clear fluid continued to emerge at the side of the catheter. It thus became evident that the bladder was not the source of the leakage, and that the kidneys corresponding to the two ureters debouching in the bladder were of normal function.

Careful urethroscopic examination of the vagina showed that there was no abnormal orifice there, nor could one be found in the vestibule. Every instrument passed hitched up momentarily against an obstacle just outside the bladder and seemed to ride over a fold or irregularity before it passed on. A No. 4 ureteral catheter passed freely to the pelvis of the left kidney, but would enter the right ureter for 1 cm. only. At this point it was gripped and blood emerged from the ureter when an attempt was made to pass it further. This appeared to show that the right ureter was narrower in bore than the left or that it was inflamed. Three hours after the examination there was a slight blue colour in the fluid leaking from the urethra.

X-ray Examination.—A radiograph showed a shadow of the left kidney normal in size, shape, and position, but the outline of the right kidney was blurred. Sodium iodide solution was injected forcibly into the urethra in the hope of outlining the abnormal ureter, but, not unexpectedly, the resulting radiograph showed nothing but a normal cystogram. On account of the age of the child and the smallness of the urethra, it was impossible to conduct a satisfactory urethroscopic examination.

PRE-OPERATIVE DIAGNOSIS.—It was evident that the case was one of supernumerary ureter on one side or the other, terminating in the urethra just outside the neck of the bladder. The orifice was probably at the point where the catheter was held up. The ureter must belong to the upper pole, following the invariable rule that the lower and more medial of the two ureters in a double kidney always belongs to the upper pole. The dye test showed lack of function and almost certainly hydronephrosis of the extra kidney, in which infection was also present. The normal part of the double kidney and the kidney of the opposite side were of good function, but also infected, one or both. The presence of an infected hydronephrotic kidney indicated its removal by partial nephrectomy rather than any handling of the abnormal ending of the ureter. The difficulty was to determine on which side the double kidney was. The possibility of the presence of two aberrant ureters, one from each side, was thought of, but seemed too remote a contingency to consider seriously. No help was obtainable from palpation or history of pain on one side or the other. The plain X-ray helped to the extent that the left kidney shadow was not enlarged and the notch of the sinus appeared in its centre, whereas if the kidney had been double, the notch would either not have been so distinct or would have been situated lower down. The right outline was too blurred to give information one way or the other. The right ureter was implanted abnormally low in the bladder and its bore was smaller than that of the left; finally, in over 80 per cent of the cases recorded where the ureter opened into the urethra the abnormality was on the right side.

Double pyelography was considered, as one pelvis might show a shortening; but as it was impossible to introduce an opaque catheter into the aberrant ureter or the right normal one, the information to be gained was doubtful and the risk definite, owing to the necessity of an anæsthetic and the presence of infection. It seemed preferable to explore the probable side—the right—and if a single kidney were found, to cut down on the other kidney.

OPERATION (April 7, 1926).—Anæsthetic: nitrous oxide and oxygen with local infiltration with novocain. The right kidney was exposed by Kelly's method through the superior lumbar triangle, the only muscle cut being the latissimus dorsi. From the upper pole near the summit a dilated and very tortuous ureter coursed downwards; it was fully $1\frac{1}{2}$ cm. in diameter (*Figs. 176, 177*). The lower pole formed the great bulk of the kidney and was separated by a slight furrow posteriorly from the upper pole. From its pelvis issued a normal and undilated ureter. The capsule of the lower part of the kidney was thickened and adherent in parts, and the cortex showed the typical scarring of infection. There seemed to be no definite separate blood-supply for the upper part of the organ, the renal artery entering about the junction of the two parts. The upper pole was removed and the raw area oversewn.

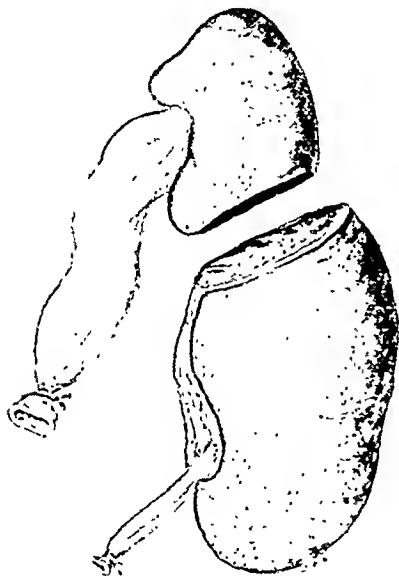


FIG. 176.—Sketch of the two segments of the right kidney removed separately. Note the widely dilated ureter of the upper portion.

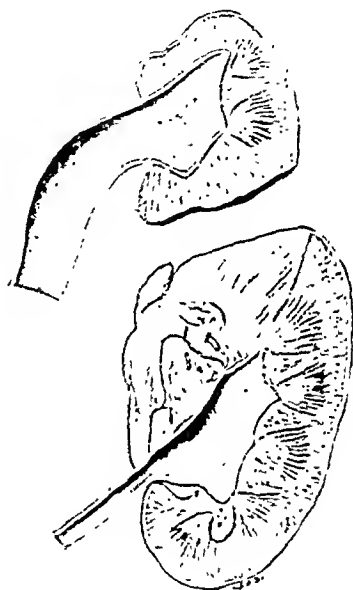


FIG. 177.—Section of the kidney. Note absence of extra-renal pelvis in both portions.

At this stage there appeared to be some interference with the blood-supply of the remainder, and as it showed such definite signs of infection it was thought unwise to leave it, so that the net result of the operation was total nephrectomy. The ureters were resected as far down as possible without enlarging the incision, and the wound was closed, leaving a small rubber-dam drain.

SUBSEQUENT PROGRESS.—There was some leakage for a few days following the operation owing to fluid remaining in the dilated ureter left behind. On the seventh day and for a short time after some pus came through the urethra from the same source. The patient was discharged on the sixteenth day and has had no leakage since. There is still, at the time of writing (Oct. 27, 1926), an occasional slight discharge of pus.

The case illustrates most of the important features of incontinence of renal origin now to be more fully discussed.

ETIOLOGY.

This form of incontinence is due as a rule to one component of a double ureter, more rarely to a solitary ureter, debouching abnormally into the urethra or the vestibule of the vagina. The condition is due to irregular development of the renal bud derived from the lower part of the Wolffian duct. To follow the origin of the variation it is necessary to consider the developmental processes involved in the formation of the bladder, urethra, and the vestibule of the vagina. Formerly it was supposed that the bladder arose from the allantois, with the exception of the trigone, which was said to be derived from the cloaca. It seems to be definitely established now that the upper part of the bladder and the urachus are derived from the ventral cloaca, while the trigone, urethra, and vestibule are in large measure Wolffian in origin. The work of W. Felix in particular has served to give prominence to the latter view, and it appears to be impossible to explain the ureteral anomalies under review on any other supposition.

In the four-weeks fœtus the Wolffian duct opens into the ventral cloaca latero-posteriorly. The renal bud—the future ureter—enters this duct from the dorsal aspect. Eventually the ureter will open into the bladder close to the site occupied at this stage by the Wolffian duct, while the latter will pass internal to it, to open as the vas deferens in the male into the distal part of the posterior urethra, or as Gaertner's duct into the vestibule of the vagina in the female. It has to be explained how this transposition occurs. A common description is that the ureter comes to open separately into the ventral cloaca, while the orifice of the Wolffian duct migrates downwards until it opens much lower down in the ventral cloaca. This migration of an orifice is difficult or impossible to conceive, and a simpler explanation seems to be available on the following lines.

Felix has shown that the lower ends of the Wolffian ducts from the fourth week onwards expand more and more—trumpet-fashion—so that they form two extensive horns whose cavities are quite indistinguishable from that of the ventral cloaca which they enter; and that it is the expanded lower ends of these ducts, whose lips fuse behind in the middle line, that actually form the trigone of the bladder. The renal bud or ureter maintains its original position. The portion of the Wolffian duct, however, from which it arose is now actually itself part of the bladder. Instead, therefore, of the ureter being transferred from the duct to the ventral cloaca, it still opens into the original structure which has itself now expanded to form the trigone.

The further development of the Wolffian duct appears to take place along the following lines. Its original lower edge is fixed and incorporated as part of the future bladder at the upper margin of the trigone. As the duct lengthens, the loop of it passes down internal to the young ureter in a downward direction, more and more of its walls expanding and being taken up to form successively the urethra and the vestibule of the vagina. Its downward progress being eventually stayed, it remains in position as Gaertner's duct in the female or the vas deferens in the male. Naturally the expansion of the duct is not uniform, the bladder and urethra being formed more at the expense of the lateral and anterior walls than of the

posterior. Any structures attached to it will remain in the same relative position during the descent. This is notably true of the renal bud and its product, the ureter. If the renal bud is implanted low down in the duct before the beginning of descent, it will open early into the bladder and accordingly be situated high up. The further it is from the lower end in the beginning, the longer it will have to wait before the section to which it is attached expands to form the urinary tract. It may be placed so high that the descent of the Wolffian duct has ceased before the part to which it is attached is used in the formation of the vestibule and urethra. In

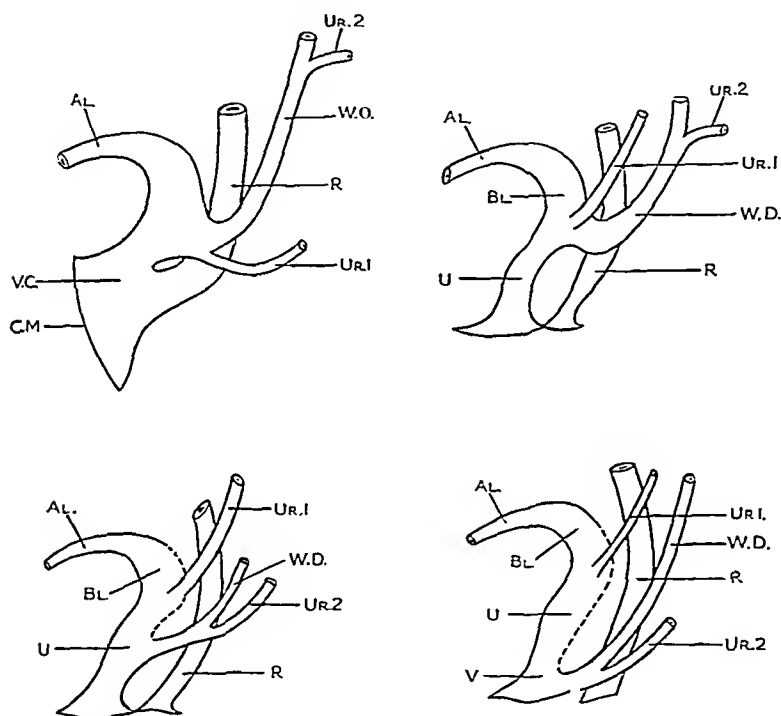


FIG. 178.—Diagrams illustrating the process by which the upper ureter comes to open in the urethra or vestibule. The dotted line indicates the portion of bladder, urethra, a vestibule formed from the Wolffian duct. A.L., Allantois; V.C., Ventral cloaca; C.M., Clo membrane; Ur. 1, The lower ureter; Ur. 2, The upper ureter; R, Rectum; W.D., Wolffian duct; U, The future urethra; V, The future vestibule.

such a case the functioning ureter would still open into the unexpanded—namely, Gaertner's duct—and the adult condition would be a Gaertner's duct from which urine flowed owing to the entry into it of an aberrant ureter. Any cystoscopist of experience must have observed an opening in a descending scrotum from above and external to the trigone to the neighbourhood of the bladder neck. More rarely they open still further down—in the urethra itself or the vestibule of the vagina. In the latter it is not easy to determine whether it is the actual ureter which debouches in the vestibule, or a Gaertner's duct kept patent by the discharge into it

a ureter which has never reached the lower urinary tract at all. Indeed, as the majority of cases of incontinence of renal origin are due to fistulæ in the vestibule, it is probable that the latter is the real condition. It is hard to conceive that in such a large number of cases the ureter itself would end exactly at this point.

In the case of twin ureters there are two renal buds arising from the same Wolffian duct. Commonly these lie very close together, so that the resulting ureteric orifices are adjacent in the bladder. In exceptional cases one bud develops much higher up than the other and gives rise to the upper pole of the double kidney. The ureter corresponding to the lower bud may open into the bladder in the normal situation, while the other does not reach the urinary tract till much later, and therefore its orifice is lower and may be in the urethra, vestibule, or even Gaertner's duct (*Fig. 178*). In some instances both ureteric orifices are lower than usual, and this fact has some value for diagnosis. If one of the two meatus seen cystoscopically is nearer to the neck of the bladder than the other, the former indicates the side of the aberrant ureter. It is inevitable on developmental grounds, and has always been borne out by experience, that a ureter opening extravasically belongs to the upper pole of the double kidney.

Bousquet, Schrader, Fleury, and Thilow (Case 2) have all recorded cases of complete absence of the bladder. In the first two the ureters opened into the urethra; in the last two into the vestibule. These can be explained only by the lack of expansion of the Wolffian ducts and their early fusion and descent, so that in one case they formed only the urethra and vestibule, and in the other the vestibule alone.

HISTORY.

As early as 1674 Schrader conducted an autopsy on a young girl in whom he found complete absence of the bladder with both ureters opening into the vestibule. Depaul, in 1852, reported a case in which, among other gross abnormalities, the right ureter entered one half of a double vagina in a non-viable foetus. Fleury, in 1874, attempted to pass a catheter in a young girl who was incontinent. She died of peritonitis as the result, and at autopsy it was found that there was complete absence of the bladder with both ureters terminating in the urethra. The first writer, however, to give the anomaly a clinical interest appears to have been Baker, who, in 1879, published two cases of his own in both of which a truant ureter opened in the vestibule. The patients had both been incontinent from birth. One was completely cured by implanting the ureter into the bladder by the vaginal route. Massari reported a similar post-mortem case in the same year. With the advance of modern methods of investigation, it was realized that in the vast majority of cases the aberrant ureter was a component of a double ureter.

INCIDENCE.

The number of reports of cases has increased during the last ten years. Altogether 73 cases are recorded, excluding that of Lawson Tait referred to by Milton. Several writers have expressed the view that this does not

reflect the real incidence, as the possibility of the condition is not visualized by those handling cases of persistent incontinence. It seems difficult, for example, to believe that no instances have occurred in the practice of British surgeons at home or abroad, while a comparatively large number have been observed in Germany, France, and America. It is of interest that several surgeons—notably Baker, Albarran, Benckiser, Burnham, Furniss, Hunner, Judd, Rumpel, Thilow and Olshausen—have reported more than one example in their personal practices. The first case put them on the alert, and a similar condition was discovered by examining all cases of incontinence by the appropriate tests.

Sex and Age Incidence.—Cases of aberrant ureter causing incontinence occur exclusively in the female sex. Corresponding anomalies occurring in the male—the ureter opening into the prostatic urethra, the vas deferens, or the seminal vesicle—are not accompanied by incontinence. The powerful external sphincter prevents this. The irritation may cause pollakiuria but never incontinence.

While the anomaly is developmental, the symptoms are not in all cases observed from birth. Where the ureter opens close to the internal sphincter, the tonicity of the latter sometimes serves to retain the urine—at the expense of renal dilatation—until the muscle is relaxed in normal micturition. In Erlach's case, for example, the incontinence, if present, was too slight to attract attention and the discovery was made at autopsy. As a rule the mother becomes aware of something wrong after the first year, but she usually ascribes it to a bad habit, and hopes that the child will 'grow out of it'.

PATHOLOGY.

This will be considered in regard to whether the aberrant ureter is supernumerary (an inaccurate term, but difficult to replace) or single; right- or left-sided; opening into the vestibule, urethra, or vagina; and to the state of the corresponding kidney as regards position, dilatation, or infection.

The cases of Bousquet, Fleury, Knöpfelmacher, Massari, Depaul, Palfyn, Schrader, and the second case of Thilow are excluded from the analysis. Some of them have been already referred to, and they all concern gross abnormalities of development in addition to the misplaced ureter. This leaves 66 recorded cases for study.

Ureter Single or Supernumerary.—Authentic cases of a true single ureter are rare—8 in all. Those of Alglave and Papin, Secheyron, Pieri, and the first cases of Judd and Thilow were definitely proved at operation or autopsy; those of Westhoff and Olshausen (Case 1) by satisfactory cystoscopic evidence. The eighth (Schroeder) is vouched for by Papin, the original report not being available.

In 42 cases the ureter was supernumerary as proved by autopsy, operation, or cystoscopy. In four of these (Alsberg, Conitzer, Obici, and Stammeler) there were double ureters on both sides, two from one side terminating normally in the bladder. In 16 cases examination was not carried out to determine this point, but a close study indicates that probably all, or most of them, dealt with supernumerary ureters.

Ureter Right- or Left-sided.—Of the single ureters, 5 were on the right side, 3 on the left. Of the remaining 58 cases, 18 were on the right, 14 on the left, and 27 not stated.

Site of Termination.—

Single Ureters.—Five terminated in the vestibule, 3 in the urethra.

Supernumerary or Doubtful.—Forty-five ended in the vestibule, 12 in the urethra, and in 1 (Furniss's second case) the orifice could not be located.

There were no certain cases in which, apart from other gross abnormalities, two supernumerary aberrant ureters were present, though possibly Madelung's may have been of this nature. These figures may be summed up in tabular form as follows :—

| <i>Description—</i> | | | | Cases | Per cent (approximate) |
|------------------------|----|----|----|-------|------------------------|
| Supernumerary | .. | .. | .. | 42 | 63 |
| Probably supernumerary | .. | .. | .. | 16 | 26 |
| Single | .. | .. | .. | 7 | 10 |
| Probably single | .. | .. | .. | 1 | 1 |
| | | | | 66 | |
| <i>Termination—</i> | | | | | |
| Vestibule | .. | .. | .. | 50 | 75 |
| Urethra | .. | .. | .. | 15 | 24 |
| Not found | .. | .. | .. | 1 | 1 |
| | | | | 66 | |
| <i>Side—</i> | | | | | |
| Right | .. | .. | .. | 23 | 35 |
| Left | .. | .. | .. | 16 | 24 |
| Not known | .. | .. | .. | 27 | 41 |
| | | | | 66 | |

The table shows that supernumerary aberrant ureters occur nine times as frequently as single ones; that the termination is nearly four times as often in the vestibule as in the urethra; and on the right side more commonly than the left. In those cases where the orifice is in the urethra, a very large proportion occur on the right side (right ureters, 12; left ureters, 4).

In many of the reports it is stated that the ending was in the vagina but it is clear that the vestibule of the vagina was really referred to. The developmental distinction between the two structures must be borne in mind. The vestibule includes a triangular area whose apex is at the junction of the two frenula clitoridis, whose lateral boundaries are the medial margins of the labia minora, and whose base is the line of insertion of the hymen. All this area and the external surface of the hymen itself is developed in part from the ventral cloaca, but chiefly from the expanded Wolffian ducts. The process by which an aberrant ureter can terminate here is exactly the same as if it ended in the urethra, and has been discussed under etiology (p. 233).

The vagina itself, however, is of Müllerian origin, and it would require a much more severe developmental wrench for a ureter to leave its Wolffian attachment and open into the Müllerian system. This certainly occurs, but only where other gross abnormalities accompany it, such as exstrophy of the bladder, persistent cloaca, double vagina and uterus, fused single kidney, atresia ani, or opening of the intestine and bladder in the abdominal wall.

These gross malformations are not very uncommon, especially in the non-viable fœtus, and only a very small proportion are dissected and reported on. In them the whole mechanism by which the cloaca, Wolffian, and Müllerian systems become organized to form the rectum, urinary, and genital systems has run riot, and almost any combination may be reproduced. The cases of Depaul, Palfyn, and Knöpfelmacher are of this type, and I have observed a similar condition in a child who died on the seventh day.

Papin carefully investigated all clinical cases in which it was stated that the truant ureter opened into the vagina, and concluded that in each it was really the vestibule that was meant. These cases were all in adult women, where the hymen had disappeared, and the distinction between the vestibule and the anterior vaginal wall was not easy to make. In Wulff's case the orifice was said to be in the labium minus, but he probably refers to the base of that structure, which is developmentally the extreme outward limit of the vestibule.

Condition of the Ureter.—In every case with one exception (Hohmeier) the ureter was dilated, and in many there were strictures at various points in addition to the narrowing at the external orifice. Hydro-ureter, and in some cases pyo-ureter, may thus be considered the practically universal rule. The cause is found in the very narrow termination, which is usually so small as to be difficult to find, and has to be slit or dilated in order to admit even a small-bore catheter. Immediately proximal to the external orifice, there is usually a cystic dilatation which may be palpated from the vagina. In Hohmeier's case there was a calculus impacted at the lower end of the abnormal ureter.

Nature of the External Orifice.—If this is in the urethra, it may appear urethroscopically to be of similar form to the normal type seen in the bladder. Sometimes it is protected by a valve or fold of mucous membrane, and this may be felt to check the passage of a catheter or cystoscope. In the vestibule the opening is as a rule very close to the external urethral meatus, but may be half an inch from it to one side above or below. In a parous woman in whom the hymen is absent it may be so far posterior as to appear to be in the vaginal wall. In a few of the reported instances (Hohmeier, Olshausen) it was wide and slit-like, in most it was punctiform, in a few (Albarran, Westhoff) cribriform. Usually it was concealed by a fold of mucous membrane, making it difficult to locate. If it lies slightly to the right or left side, the ureter belongs to that side of the body.

Condition of the Corresponding Kidney.—In one of the cases accompanied by other abnormalities there was a fused single kidney, with two ureters—one aberrant: in the others two kidneys, both single, both double, or one single and one double. Where the ureter arises from a double kidney it invariably belongs to the upper pole. The double kidney is of the common type, one portion being larger and richer in function than the other, the two being separated by a ridge, more or less marked. While the ureter is widely dilated, there is not always a corresponding dilatation of the pelvis of the partial kidney—in fact, not infrequently there is no properly defined pelvis at all. Hydronephrosis, however, is common, and sometimes (Rumpel, Alglave, and Papin) there is pyonephrosis.

Presence of Infection.—The study of this feature is of importance in considering the correct treatment. It is not clearly indicated in many reports, but in 15 infection was definitely ascertained to be present, while in only 7 was the urine proved to be sterile. The younger the patient, the more chance of the absence of infection, but in the case reported here it appeared to have set in during the third year of life.

Function of the Affected Kidney or Half-kidney.—As nephrectomy or partial nephrectomy will be the operation of choice in many cases, great stress should be laid on this point. Full reports are available in five of the cases of single kidney. Alglave and Papin found a completely destroyed and pyonephrotic kidney with no function, Pieri one suppurating and practically functionless. In the cases of Olshausen and Westhoff the normal organ was doing practically all the work. In that of Judd the ureter was transplanted, and after much treatment was eventually able to function half as well as its fellow.

In practically every case where the ureter was supernumerary, the function, as shown by the quantity of urine and dye tests, was insignificant as compared with the opposite side or the other portion of the kidney on the same side. This indicated a comparatively small upper section of the double kidney or one destroyed by dilatation and infection.

SYMPTOMATOLOGY.

Diurnal and nocturnal incontinence, side by side with regular normal micturitions, is the characteristic symptom. The leakage is always worse in the day and is more or less continuous; it may only amount to slight staining of the sheet at night. In cases where the abnormal orifice is close to the bladder sphincter in the urethra, incontinence may be noticed only after some event such as child-birth which has weakened the sphincteric control. Kolisko had a case of this nature in a woman of 21, in which there was no history of incontinence at all. The widely dilated ureter may act as a reservoir, so that the incontinence is intermittent and may occur on coughing or straining. It is almost characteristic that some days may be passed in which the patient is practically dry. This is always followed by a period in which the incontinence is worse. Pain may be felt in the corresponding kidney or along the line of the ureter, but this is rare even in moderately infected cases. Gross infection with pus formation may cause the urinary leak to be replaced by a discharge of pus, and be accompanied by severe pain of a constant or intermittent nature over the ureter or kidney. Tenderness may be elicited in the same region in cases of less severity. There is frequently inflammation and excoriation about the vulva owing to the constant wetting. By vaginal examination a cystic swelling or thickening may be felt in the line of the ureter. The general health is excellent unless sepsis is advanced.

DIAGNOSIS.

This embraces the *fact* of aberrant ureter, the side to which it belongs, whether it is supernumerary or single, the presence of infection or dilatation of the ureter, and the functional value of the renal element involved.

If the history is of incontinence with normal micturition, and urine is seen to drip away from the vestibule or urethra after the bladder has been emptied with a catheter, the diagnosis of aberrant ureter is almost certain. The rhythm of the drip is similar to that from a ureter draining through a ureteral catheter. When the bladder is filled with a coloured solution—indigo-carmin or methylene blue—the urine dripping away remains clear. In some cases it may be necessary to make repeated examinations before the leak is observed.

A striking feature is the difficulty in locating the abnormal orifice even when it is known to be present. Pains-taking examination with the help of a magnifying lens in order to find the opening in the vestibule may be necessary, while if it is in the urethra a water-dilating urethroscop may disclose it in the adult. In young children it will usually be impossible to do this, on account of the small urethra and the difficulty in getting sufficient dilatation.

There should be no difficulty in differentiating the ordinary type of enuresis in which there is copious bed-wetting after which the bladder is empty. In aberrant ureter the function of micturition is normal, though there may be frequency from concurrent infection. There is, however, a class of cases of diurnal incontinence in children where, through weakness of the bladder musculature owing to infection or other cause, a small quantity of urine escapes on exertion. The symptom does not as a rule begin till after the age of 6. The patients should be closely observed, preferably in hospital. Methylene blue is given by the mouth to keep the urine coloured, and filter paper covered with a gauze swab is placed on the vulva so that the smallest leakage may be observed. If after a week of observation in the recumbent position there is no staining, aberrant ureter can probably be excluded.

In adult cases where incontinence takes place only on coughing or exertion, the diagnosis may be very difficult, as the same symptoms frequently occur through weakening of the vesical sphincter. In these and in cases of vesicovaginal fistula the history should lead to thorough urological examination. The vagina can be satisfactorily examined by the urethroscop in the youngest child. The cystic ureter may be palpated through the anterior wall of the vagina, and urine may be expressed from it.

Site of the Ureter and whether Supernumerary or Single.—Where the orifice is in the vestibule and lies to one side of the middle line, the ureter belongs to that side. If it is in the middle line, its course may be traced by dilating the orifice and inserting a sound. Palpation through the anterior vaginal wall will disclose the sound deviating to one side as it ascends. This also indicates the side of the ureter. As the great majority of cases are of supernumerary ureter, the cystoscop will reveal two apparently normal ureteric orifices in the bladder. If these are not symmetrical in position, the least normal will probably belong to the double kidney. In the case reported above, the ureteric orifice of the abnormal side was nearer to the neck of the bladder and narrower in bore than the other.

If an opaque catheter can be inserted into the supernumerary opening, the exact nature of the ureter and its kidney may be studied urographically. The insertion of the catheter as far as the pelvis is not, however, always possible, on account of the strictured and tortuous ureter, and it may not be

considered advisable to take a ureterogram owing to the difficulty in recovering the opaque fluid.

If the ureter opens in the urethra, similar methods may be available in the adult. In the infant or young child they are rarely practicable. Double pyclography with catheters in both normal ureters is dangerous, and might give results very difficult to interpret. Plain X rays will rarely give useful information. If the two kidney shadows are well shown, the one that is largest and whose notch is not in the centre is probably the double organ.

Closing the visible orifice to produce pain in the corresponding side is a diagnostic measure belonging to 'pre-radiographic days.

Infection.—The presence of infection can be ascertained by the offensive smell of the discharge, or by examination of urine recovered through a ureteral catheter if one can be inserted.

Function of the Corresponding Kidney or Half-kidney.—In the adult exact function tests may be carried out by the insertion of three catheters and the study of the separate urines and dye elimination. In the infant the most convenient test is to inject 10 c.c. of indigo-carmin intramuscularly before the examination. In children of 5 or more it is easy to inject the dye into the median basilic vein. The orifices in the bladder are then observed with the cystoscope. If the dye is seen to appear in good concentration and strong efflux from each ureter in the bladder in the case of double kidney, or from the single orifice in other cases, while the urine leaking away is hardly coloured, it may be concluded that the kidney or part-kidney supplying the leak is small or hydronephrotic. If a large proportion of the urine is coming from the leak, and this becomes blue-coloured at the same time as the dye appears in the bladder, the appropriate kidney has considerable function, and efforts should be made for its preservation.

PROGNOSIS.

Spontaneous cure is almost impossible. In the cases of Kolisko and Secheyron the external orifice appears to have been so minute as to have closed spontaneously with atrophy of the kidney. The outlook as regards life is dependent on the rapidity of onset and severity of infective changes. Apart from these the condition does not shorten life. The state of untreated patients, however, is miserable in the extreme, and the mental effect deplorable. The result of surgical treatment is excellent.

TREATMENT.

In most instances the diagnosis has been a surprise, and each surgeon has carried out a procedure devised by himself. A table of the typical operative procedures is given in the article by Furniss, to which reference may be made. In most of the early cases the ureter was ligatured either at the abnormal orifice or after dissecting it up from the vagina. The result in infected cases was severe reaction, followed by the breaking-down of the ligature and recurrence, and even death.

Low implantation into the bladder has the advantage that it is not necessary to ascertain the side of the ureter. It has not proved very satisfactory,

and the literature abundantly illustrates how frequently two, three, or four subsequent operations were required for the closure of vesicovaginal fistula and further treatment of the ureter.

Isolation of the ureter by abdominal operation and transplantation into the bladder is advocated by Judd as a conservative measure. His case was one of single kidney, and after repeated treatments by pelvic lavage to control infection, the transplanted kidney only attained to half the function of the other.

It is to be hoped that with better diagnosis the operation will be performed on young children, and the correct therapy must be considered from this point of view.

The proper procedure depends on: (1) The presence or absence of infection; (2) The relative function of the kidney or portion of the kidney concerned; and (3) The soundness of the remaining kidney. The usual type of case is one in which the kidney has little function, the ureter is dilated and possibly strictured, and infection is present. In these the only logical treatment is partial nephrectomy with or without the removal of the ureter at the same sitting. It is a simpler operation than implantation by abdominal section, and it removes a practically useless organ, eliminates a focus of infection, and cures the incontinence at the same time, without causing cystitis by introducing sepsis into the bladder. The question of the simultaneous removal of the ureter is governed by exactly the same factors as would lead to its removal in cases of nephrectomy where it ran a normal course. In most cases it should take up and cause no further trouble. It may, if widely dilated and infected, continue to cause an intermittent pus discharge through its lower end. Papin, after partial nephrectomy, had to operate again to drain the dilated lower part of the ureter into the vagina.

Where the escaping urine has been proved to be absolutely sterile and the function of the abnormal portion of the kidney is small, simple obliteration or ligation of the ureter may cause the appropriate kidney substance to undergo quiet atrophy. The procedure is almost a minor operation—dissecting the lowest portion of the urethra through the anterior vaginal wall, and ligaturing after resection of the lower end. If there is severe reaction, a second operation on the kidney and ureter from above may be necessary. Hunner resected the whole length of the ureter in a girl of 12, leaving the kidney untouched, and the case did well.

In those rare cases where the kidney belonging to the aberrant ureter is performing a considerable share of the total renal function, some form of implantation is advisable. This can be done most successfully by high extraperitoneal approach.

In the overwhelming majority, however, partial nephrectomy is the operation of choice. The most probable side having been determined, the kidney is exposed by the Kelly method through the superior lumbar triangle. The double nature of the organ will be quickly recognized. Should the case be one of supernumerary ureter and the exposed kidney be single, a mistake has been made, and the wound should be stitched up and the other kidney cut down upon. As a rule, there is a ridge or marking to show the limitation of the upper pole which is the part to be excised. The pedicle having been

temporarily controlled, the organ should be cut across at the level of the ridge. A wedge-shaped portion is then removed at the expense of the remaining part of the organ so that the edges may be brought together. Hæmostasis should be secured by this means alone, as the ligature of any of the vessels entering the kidney may endanger the blood-supply of the part that it is wished to leave. The upper ureter should be cut across as low down as convenient without enlarging the incision.

If the walls of the ureter are greatly thickened and the lumen is full of purulent urine, the whole ureter should be excised by making a separate muscle-splitting incision lower down. The operative mortality should be practically nil.

SUMMARY.

1. There is a rare type of urinary incontinence caused by an aberrant ureter opening into the urethra or the vestibule of the vagina.

2. The cardinal symptom is incontinence side by side with normal urinary function.

3. The abnormality is explicable only by presupposing that the Wolffian ducts enter into the formation of the female urethra and vestibule.

4. Usually the abnormal ureter is one component of a double ureter, so that cystoscopy reveals two normal ureters in the bladder.

5. The ureter is generally dilated and infected and belongs to a kidney which is diseased and has little function.

6. The usual treatment should be nephrectomy or partial nephrectomy, but in clean cases ligature of the ureter may suffice. If the kidney is performing a large share of the renal function, the aberrant ureter should be implanted into the bladder by high operation.

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THE RELATION OF TUBERCULOSIS TO KÖHLER'S DISEASE.

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SOME four years ago¹ I advanced evidence and arguments in an attempt to show that Köhler's disease is due to a blood-borne infection of the tarsal scaphoid setting up an osteomyelitis. The balance of evidence indicated the *B. tuberculosis* as the causative organism. An undoubted case of the disease was described; in the skiagram a tiny sequestrum could be discerned separated from and lying loose in the soft tissues near to a corresponding hollow in the scaphoid bone of the right foot. Complete recovery ensued without any breach in the continuity of the skin; this has happened in every case hitherto recorded, so that no opportunity of investigating the histological condition of the affected tissues had, at that time, arisen. The boy's parents suffered from tuberculosis of the lungs, and he himself afterwards developed phthisis. The deduction that the offending organism was the *B. tuberculosis* could claim, at last, a reasonable degree of probability.

By a different path Fassett² in 1914 had arrived at a similar conclusion. More recently Lawford Knaggs³ described Köhler's disease as tarsal scaphoiditis, assuming thereby an inflammatory origin. He says, "It is probable that serous osteomyelitis is also responsible for the condition", and again, "It is very likely to be mistaken for tuberculous disease". These statements indicate an approach to a more precise pathological conception, and to a discarding of the various recondite, but largely speculative, theories that have cumbered for so long the orthodox teaching on the disease. The term 'serous osteomyelitis' is descriptive and carries implications—the production of a fluid serous exudate free from the gross characteristics of pus, by an inflammation due to pathogenic organisms or to their toxins. It is still confidently reiterated that the disease always ends in complete recovery.

The scaphoid of the foot, small bone though it be, is yet the keystone of the arch. In the architecture of the foot it is the most prominent of all the tarsal bones, more exposed to trauma, subjected to strains and pressure at every step. Even a mild osteomyelitis there is likely to cause pain and a limping gait in a child at an early stage, commanding treatment by rest. There is small wonder, therefore, that complete recovery without abscess formation should occur in most cases.

Tuberculous disease of the ankle-joint is so subtle in onset that, as a rule, little can be ascertained about its true genesis. Beginning usually in the astragalus or os calcis, less commonly in the cuboid, the disease is often overlooked at its inception, only challenging observation when the process has already spread to neighbouring bones. In a young adult (Miss J., age 17 years) now under observation tuberculous disease is seen plainly (in a

radiograph taken four months ago) to be confined to the scaphoid and cuboid; this was at the earliest onset of acknowledged symptoms; now the whole tarsus is involved and no indication remains as to the primary focus. If the disease should begin in the scaphoid, pain would be more likely to compel recognition at a stage earlier than would obtain if it began in either astragalus or cuboid.

The case detailed below may serve to crystallize our conception of tarsal scaphoiditis, since an opportunity has now occurred of following the disease from its earliest stage to a disastrous conclusion, and of investigating microscopically its pathology.

Oliver T., age 3½ years, without any known history of previous injury, began to limp in the right leg. A tender, painful swelling on the arch of the right foot was noticed by his parents. He was taken to

Dr. Evans, who referred him to me on July 20, 1925. The boy's general health was poor, but he was free from pyrexia or any sign of disease other than the local condition. The physical signs were typical, a tender, slightly painful swelling over the scaphoid of the right foot, without redness or œdema, and causing a well-marked limp in walking.

On July 22, 1925, Dr. Harrison Orton X-rayed the feet and reported: "From a comparison of these you will see that the scaphoid is denser and smaller on the right side than it is on the left, and I think there is no doubt this is a case of Köhler's disease." (*Figs. 179, 180.*)

The foot and leg were put up in plaster-of-Paris, but five weeks later this was removed on account of pain. The swelling over the scaphoid, however, became larger, slight reddening of the skin covering it appeared, and fluctuation could be felt. On Sept. 26 aspiration with a fine



FIG. 179.—Right foot.



FIG. 180.—Left foot.

needle yielded pus, on which Dr. Kayvett Gordon reported: "In stained films of the pus no tubercle bacilli were found. By cultivation of the specimen pneumococci have been isolated."

The whole ankle-joint now became swollen; the patient was admitted to hospital on Oct. 10, and on Nov. 10 free incisions became necessary (Fig. 181, A and B). A small portion of the soft tissues over the scaphoid was excised and was "found to consist of granulation tissue of pyogenic origin, there being no evidence of tuberculous or malignant disease."



FIG. 181.

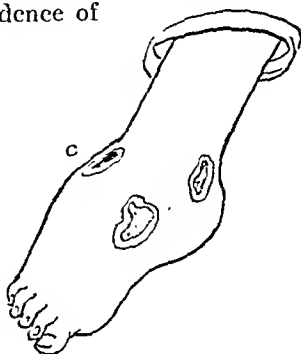


FIG. 182.

By Nov. 21 the disease had made further progress; a new sinus (Fig. 182, C) had appeared; a radiograph showed rarefaction of the tarsal bones and definite necrosis of the astragalus (Figs. 183, 184). On Dec. 3



FIG. 183.

the pus showed "no tubercle bacilli, but many Gram-positive cocci were present. By cultivation *Staphylococcus aureus* has been isolated."

Despite open-air treatment and further free incisions (Jan. 22, 1926) the condition did not improve. Hitherto the disease had remained localized to

the neighbourhood of the ankle-joint, but now more fresh foci of infection appeared (*Fig. 185, c*) and amputation became necessary. This was done through the lower third of the leg on Aug. 1. Rapid healing and rapid

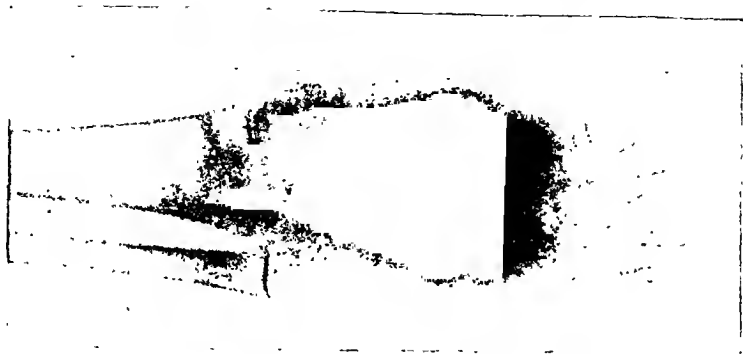


FIG. 184.

improvement in general health followed, and the patient was discharged from hospital on Sept. 26.

The report by A. Knyvett Gordon on the portion of limb removed is interesting: "Section from os calcis in a state of necrosis and infiltrated with gelatinous granulation tissue. There was a similar cavity in the scaphoid with a loose sequestrum. This section shows infiltration with typical tuberculous granulation tissue with secondary pyogenic infection."

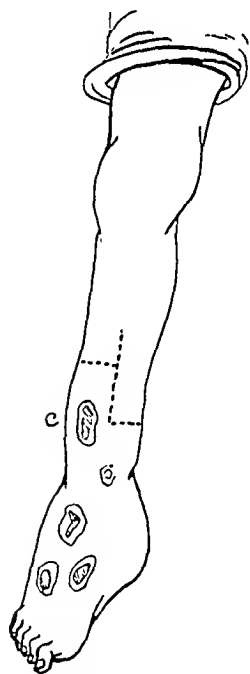


FIG. 185.

There is general agreement that a diagnosis of Köhler's disease is justified if the following criteria obtain: (1) The affected bone is smaller than normal; (2) The outline of the bone is irregular; (3) The density of the bone is increased; (4) The architecture of the bony trabeculae has disappeared; (5) The general shape of the scaphoid is altered, being flattened from before back and not widened from side to side.

The case under consideration fulfils these conditions, and there seems no doubt that when first observed a diagnosis of Köhler's disease was justifiable. The terminal condition was 'beyond a peradventure' one of tuberculosis of the tarsus. In the early stage the presence of an infective organism (*pneumococcus*) was demonstrated before breach of continuity of the skin allowed any avenue of approach for the organism other than by the blood-stream.

It would seem reasonable to deduce that the primary infection was by the *B. tuberculosis*, accompanied by the less persistent *pneumococcus*; and that, in effect, the *B. tuberculosis* produced a condition indistinguishable, either by clinical

signs and symptoms or by X-ray demonstration, from the classical entity known as Köhler's disease.

CONCLUSIONS.

1. There are good reasons, already given, why tarsal sephoiditis should almost invariably result in a *restitutio ad integrum*; the pathology of the condition thereby has lacked the ultimate proof of histological examination.

2. The foregoing case leaves little doubt that the disease is due to a blood-borne infection of low pathogenicity—in this instance the pneumococcus, followed later by the *Staphylococcus aureus* (which must be regarded as being due to accidental contamination).

3. The supervention of tuberculosis, which rendered amputation necessary, finds its parallel in the lungs, where *B. tuberculosis* not infrequently follows the pneumococcus. It may be that the infection was, from the onset, a dual one, the *B. tuberculosis* only becoming dominant in the later stages; but the problem of symbiosis is foreign to the purpose of this paper, which is to establish the reality of infection by a definite organism as the real cause of the disease.

4. The term 'tarsal sephoiditis' is in accordance with the known pathology of the disease. The term 'Köhler's disease' has been applied to an early and abortive infection of the tarsal sephoid by the *B. tuberculosis*.

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¹ GREENWOOD, *Lancet*, 1923, ii, 274.

² FASSETT, *Jour. Amer. Med. Assoc.*, 1914, lxii, 1155.

³ LAWFORD KNAGGS, *Inflammatory and Toxic Diseases of Bone*, 54. Bristol: John Wright & Sons Ltd., 1926.

**A NEW METHOD FOR THE RAPID MICROSCOPICAL
DIAGNOSIS OF TUMOURS:
WITH AN ACCOUNT OF 200 CASES SO EXAMINED.**

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VARIOUS methods have from time to time been introduced for the rapid microscopical examination of new growths and inflammatory tissues removed at operation, but on the whole the results have not been satisfactory, owing to the imperfect preparations obtained in the short space of time allowed. The late Professor S. G. Shattoek, to whom English surgeons of experience referred for a final opinion on the microscopical examination of new growths, was strongly opposed to methods of rapid diagnosis, owing to errors dependent upon the technique and the short time available for microscopical examination. Dr. E. H. Shaw¹, however, has done much work on the perfecting of a method for the rapid diagnosis of new growths, and in his hands the results obtained have been very successful.

It occurred to us that as perfect preparations of intestinal parasites are obtained when films of intestinal mucus or feces are fixed *in the wet* in Schaudinn's fluid, it might be possible to employ this method for the examination of new growths. Dudgeon and Jewesbury² used Schaudinn's solution for the cytological examination of human milk, and as a result obtained beautiful preparations of the various cells. In our hands wet films of new growths and inflammatory tissues removed at operation have given a rapid and easily workable technical method. The results of the first 200 consecutive specimens studied by this method, upon which this paper is based, have been very successful, as judged by the control examination of sections of the same tissue prepared in paraffin by the usual technique.

Experience is required for this rapid method, as for all other laboratory methods, and it is essential to possess a sound knowledge of the microscopical study of new growths and inflammatory tissues by the usual technique. We consider that the advantages of the method are the beautiful preparation of individual cells and fragments of tissue which are seen in the films, the simplicity of the technique, and the small amount of material required for the preparation of the films; all the necessary apparatus, with the exception of the microscope, can easily be carried in a portable case 12 in. by 8 in. by 3 in. Mistakes have occurred, but they are few in number, and only 6 out of 200 examinations were definitely serious errors. It is possible that in course of time, and with greater knowledge of this method, such mistakes will be less

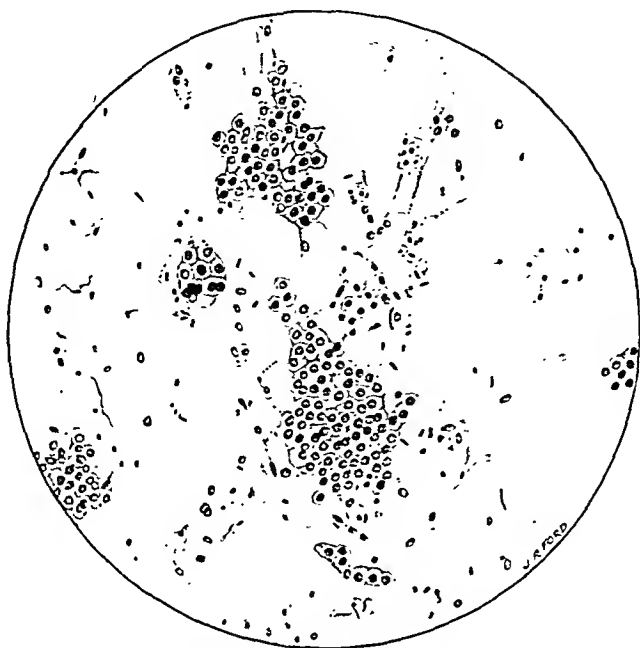


FIG. 186.—Case 175. Adenoma of prostate gland. Note clear outline and regularity in size of individual cells in the fragments of tissue, and the relative scarcity of isolated epithelial cells. ($\times 185$.)

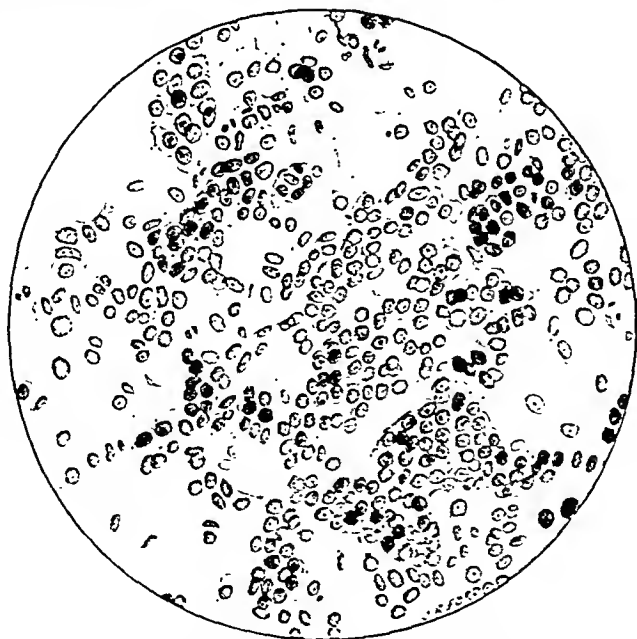


FIG. 187.—Case 115. Spheroidal-celled carcinoma of breast. Note large size of cells, plaques of cells, and the large number of isolated cells. ($\times 185$.)

frequent; but it is difficult to believe that by any rapid method some errors will not occur, when we consider that the microscopical diagnosis of some new growths requires long periods of exhaustive examination. For these reasons we feel confident in recommending the wet-film method for the rapid diagnosis of new growths and inflammatory conditions. It is only fair to add that a correct diagnosis was made in the majority of instances without any knowledge of the clinical condition or of the macroscopical appearance of the new growth. It was considered that, in testing a new method of this nature, it was important to dispense with this valuable assistance.

TECHNIQUE.

The tumour or other tissue is cut into, and the freshly-cut surface scraped *firmly* with a sharp scalpel. The milky juice so obtained is spread evenly on slides and put immediately into Schaudinn's fluid *while still wet*. The composition of this fluid is as follows: (1) Saturated solution of mercuric chloride in distilled water, 2 parts; (2) Absolute alcohol, 1 part. A few drops of glacial acetic acid are added so as to obtain 4 per cent of the acid in the solution.

The wet films are allowed to remain in this fluid from two to ten minutes according to circumstances. If rapidity is essential, then an absolute minimum time of two minutes can be employed, but the best preparations are obtained by ten minutes' fixation. In some cases the wet films were placed in warm Schaudinn's fluid, but no advantage was obtained. Time will be saved if the tissue is scraped and the wet films are put into the fixative in the operating theatre, so that fixation will take place during transit from the operating theatre to the laboratory. The films are afterwards washed in spirit, and then in distilled water. Mayer's hæmalum is employed as the nuclear stain, and eosin as the counterstain. Dehydration and clearing are done with absolute

Table I.—RESULTS OF TOTAL OF NUMBER OF CASES EXAMINED.

| CLASSIFICATION BY PARAFFIN SECTIONS | NUMBER OF CASES | DIAGNOSES MADE ON FILMS | | |
|--|--------------------|--|---------------|-----------|
| | | Correct as regards leading feature (e.g., malignancy) | Fully correct | Incorrect |
| <i>Inflammatory</i> | 51 | | | |
| 1. Simple .. | 43 | 42 | 36 | 1 |
| 2. Tuberculosis .. | 7 | 7 | 6 | 0 |
| 3. Syphilis .. | 1 | 1 | 0 | 0 |
| <i>Lymphadenoma</i> .. | 2 | 2 | 2 | 0 |
| <i>Neoplasms</i> .. | 143 | | | |
| 1. Simple .. | 33 | 29 | 23 | 4 |
| 2. Carcinoma .. | 89 | 86 | 83 | 3 |
| 3. Sarcoma .. | 16 | 15 | 13 | 1 |
| 4. Endothelioma | 5 | 5 | 4 | 0 |
| <i>Various</i> | 4 | 4 | 2 | 0 |
| Total | 200 | 191 | 169 | 9 |

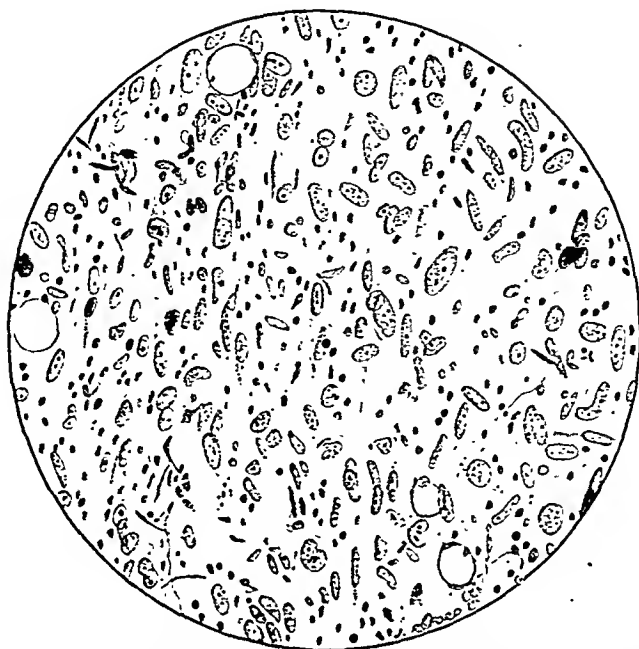


FIG. 188.—Case 90. Spindle-celled sarcoma of humerus. Note great variation in size of the tumour cells and their almost complete separation from each other. Many red blood-cells are present. ($\times 185$.)

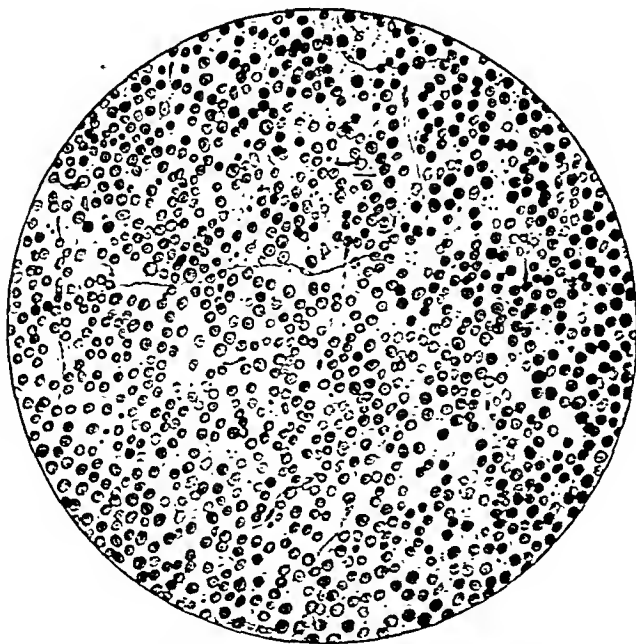


FIG. 189.—Case 184. Round-celled sarcoma of tonsil. Note the almost uniform distribution of round cells, which are larger and less deeply stained than lymphocytes. ($\times 185$.)

alcohol and xylol, and the films are then coverslipped with Canada balsam. The total time required for the technical process can be as short as eight to ten minutes, but the time required for the microscopical examination is dependent upon the nature of the tissue and the rapidity of the investigator.

In *Table I* are shown the results of the first 200 consecutive cases examined by this method. Glands removed with a primary tumour and examined separately have not been included in this table, the microscopy of the primary tumour only being considered. It will be seen that in 169 of the 200 cases a definite and correct microscopical diagnosis was made on the Schaudinn films alone; and in 191 cases the diagnosis made was correct but incomplete; it being correctly stated in 22 cases whether the specimen was simple, malignant, or inflammatory, but the exact nature not being fully determined on the film alone. In some 15 cases the rapid microscopical report was awaited by the surgeon, and utilized to decide the course of the operation; in all these cases a correct diagnosis was returned.

ERRORS IN DIAGNOSIS.

Of the 9 erroneous diagnoses made on the films, 6 occurred in the first hundred examined, and 3 in the second hundred. In the third hundred, now under examination but not reported here, one mistake has so far been made. The 9 mistakes made were as follows:—

Two cases (39 and 73) were ulcers of the lower lip. One was a septic ulcer which was returned as carcinomatous owing to the presence of altered epithelium from the edge of the ulcer; and the other which was actually carcinomatous, was reported as ‘no *definite* evidence of carcinoma’. In the films from both cases the inflammatory reaction was the most marked feature, but the scrapings were made from *ulcerated surfaces*. In later cases the scrapings have been made only from the *cut surface of the deeper tissue*, and a considerable series of ulcers from the mouth, tongue, and lip has since been examined without a mistake.

One case (81) was of a nodule stated to have been removed from the peritoneum. The film report reads: ‘suggests normal intestinal mucosa’, but in view of its alleged origin it was labelled ‘columnar-celled carcinoma’. It proved to be the apex of a diverticulum from a case of diverticulitis, which had penetrated the bowel wall as far as the peritoneal coat. This possibility was not suggested by the operator’s description of the specimen, and did not occur to us as a possible explanation at the time of the examination.

Two cases (32 and 176) were of lymphatic glands examined for secondary deposits of carcinoma. The scrapings showed no evidence of carcinoma, but sections, necessarily taken at a slightly different plane in the glands, showed a small islet of carcinoma in each case. This discrepancy might occur with two different paraffin sections taken at different depths in a gland, and is no criticism of the film method; the presence of a small deposit of growth in a gland can, of course, only be excluded by the examination of a considerable number of sections of the entire gland.

Four errors were made in breast tumours. One (114) was judged on the film to be ‘an inflamed fibroma’, but the section showed it to be a fibrosarcoma.

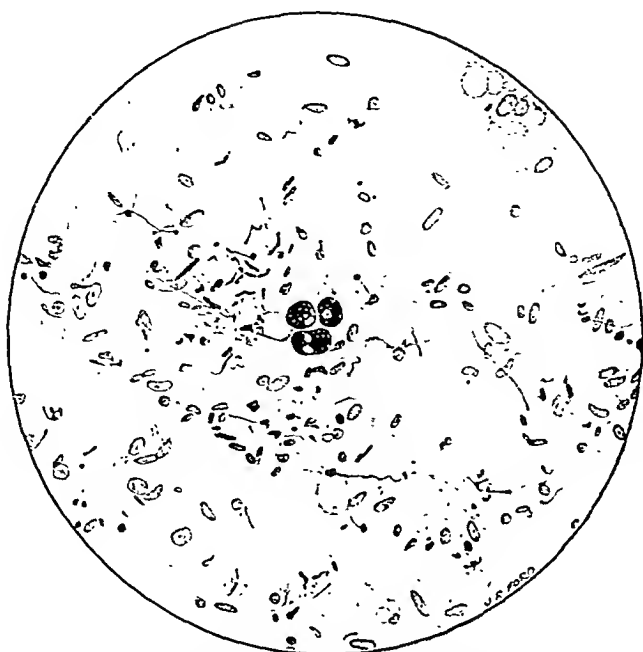


FIG. 190.—Case 154. Organizing hæmatoma. Note the presence of connective-tissue cells of various shapes and sizes. Three large cells in centre of picture contain blood pigment. ($\times 185$.)

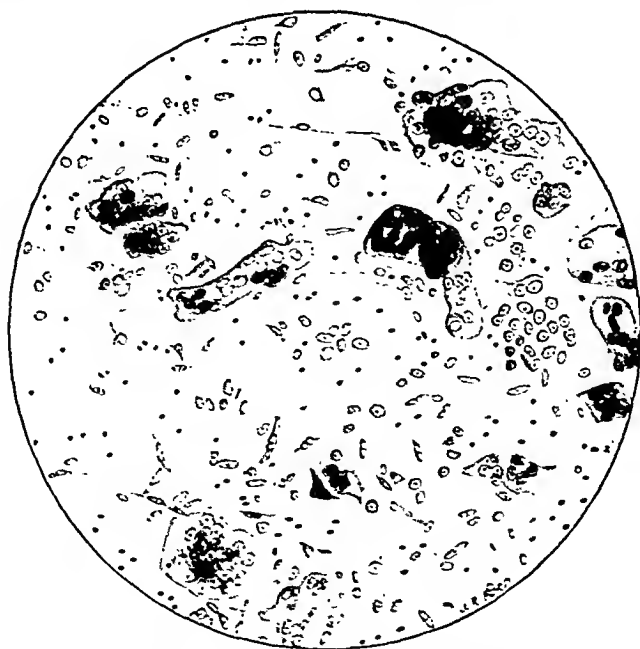


FIG. 191.—Case 93. Giant-celled sarcoma of fibula (myeloma). Note the very large multinucleated cells, and the scattered spindle cells of the stroma. ($\times 185$.)

Clinical experience has shown that this error may occur even with the best paraffin sections. Two other breast cases (48 and 63) were fibro-adenomata examined early in the series; one was returned as 'atypical carcinoma', and the other as 'epithelial tumour, not distinguishable from carcinoma'. The last mistake, also a breast case (134), is the most serious. Films of the tumour show what appears to be a typical spheroidal-celled carcinoma, exactly similar to the large number of other breast carcinomata examined and reported on correctly, and quite unlike any films from simple tumours that we have made. The paraffin sections show a typical adenofibroma.

RESULTS IN DETAIL.

Table II shows the detailed results of the first 200 cases examined, arranged under the organ or system from which each specimen was obtained. It should be noted that the diagnosis made at operation was sometimes misleading in its indication: e.g., a 'cyst of neck' examined proved to be a breaking-down carcinomatous gland and has therefore been classified under section *G* of this table, and some cases of 'glands of the neck' proved on microscopy to belong to the salivary-gland section *D*. Where both a growth and the appropriate lymph glands were examined, the case is entered under both headings in this table.

The results of the connective-tissue and bone cases are given in full, as a sample of the actual results that may be expected by this method. The remaining groups of cases have been analysed, owing to the large amount of space that would be required to deal with the whole results in detail.

Table II.—RESULTS ARRANGED IN GROUPS UNDER THE ORGANS OR SYSTEMS WHENCE THE SPECIMENS WERE OBTAINED.

A. CONNECTIVE TISSUES AND BONES (18 Cases).

| CASE NO. | ORIGIN OF SPECIMEN | SECTION DIAGNOSIS | FILM DIAGNOSIS |
|----------|---------------------------|---|----------------------------------|
| 2 | Muscles of arm | Spindle-celled sarcoma .. | Spindle-celled sarcoma |
| 5 | Muscles of arm | Spindle-celled sarcoma .. | Spindle-celled sarcoma |
| 43 | Clavicle .. | Syphilitic bone | No evidence of malignant growth |
| 55 | Tendon sheath of thumb .. | Granuloma with fibrosis and old hæmorrhage. Limited number of large giant cells | 'Myeloma' |
| 57 | Ulna | Calcifying chondroma .. | Hyaline cartilage |
| 66 | Femur | Round-celled sarcoma .. | Round-celled sarcoma |
| 72 | Popliteal space | Spindle-celled sarcoma | Sarcoma, probably spindle-celled |
| 88 | Groin | Myxosarcoma | Spindle-celled sarcoma |
| 90 | Arm | Spindle-celled sarcoma .. | Spindle-celled sarcoma |

Table II.—RESULTS IN DETAIL, continued.

| CASE NO. | ORIGIN OF SPECIMEN | SECTION DIAGNOSIS | FILM DIAGNOSIS |
|----------|--|---|--|
| 93 | Fibula | Giant-celled sarcoma : stroma fibromatous rather than sarcomatous | Giant-celled sarcoma |
| 99 | Ulna | Myxochondroma | Myxochondroma |
| 122 | Malar bone .. | Spheroidal-celled carcinoma | Spheroidal-celled carcinoma |
| 142 | Tibia | Round-celled sarcoma .. | Large round-celled sarcoma |
| 146 | Muscle of neck (case of carcinoma of larynx) | Chronic interstitial myositis.. | No evidence of carcinoma |
| 157 | Muscle of tongue (case of carcinoma) | No evidence of carcinoma .. | Striped muscle-fibres and fatty tissue : no evidence of carcinoma |
| 170 | Radius, fractured at site of pre-existing tumour | No evidence of malignancy. Old hæmorrhage in fibro-fatty tissue | Hæmatoma. Blood pigment inside fibroblasts, and one myeloplax present |
| 185 | Skin | Blood-clot | Blood ; red cells almost entirely disintegrated. No evidence of neoplasm |
| 185 | Spine | Endothelioma of meninges .. | Round-celled sarcoma |

B. SKIN, TONGUE, LIP, Etc. (37 Cases).

| SECTION DIAGNOSIS | NO. OF CASES | FILM DIAGNOSIS | NO. OF CASES |
|--|--------------|--|--------------|
| Squamous-celled carcinoma .. | 13 | { Squamous-celled carcinoma 11 Carcinoma 1 Inflammatory, no positive evidence of carcinoma 1 | |
| Basal-celled carcinoma | 5 | { Basal-celled carcinoma 4 Malignant tumour 1 | |
| Papilloma | 5 | Papilloma | 5 |
| Sebaceous tumour | 3 | Sebaceous tumour | 3 |
| Hæmatoma | 1 | Hæmatoma | 1 |
| Non-specific inflammation | 8 | { Non-specific inflammation 7 Squamous-celled carcinoma 1 | |
| Chronic granuloma, probably tuberculosis, possibly syphilis .. | 1 | Chronic inflammation, tuberculosis or possibly syphilis | 1 |
| Round-celled sarcoma | 1 | Round-celled sarcoma | 1 |

Table II.—RESULTS IN DETAIL, *continued*.

This group includes the two errors made in lip ulcers already described (p. 254). In the other cases, including a granuloma of the nasal septum, sent with a clinical diagnosis of sarcoma, the film report was scarcely improved upon by the diagnosis made on the section.

C. **THYROID** (9 Cases).

All were correctly reported on the films as non-malignant, and the diagnosis of exophthalmic goitre was correctly made in one out of two cases.

D. **SALIVARY GLANDS** (9 Cases).

| SECTION DIAGNOSIS | NO. OF CASES | FILM DIAGNOSIS | NO. OF CASES |
|--------------------------------|--------------|---|--------------|
| Myxo-endothelioma | 4 | { Myxo-endothelioma 3 Malignant tumour 1 | |
| Normal salivary gland | 1 | Normal salivary gland | 1 |
| Lipoma | 1 | Fatty tissue only | 1 |
| Spheroidal-celled carcinoma .. | 2 | Spheroidal-celled carcinoma | 2 |
| Spindle-celled sarcoma | 1 | Spindle-celled sarcoma | 1 |

E. **GASTRO-INTESTINAL TRACT** (21 Cases : stomach 7, liver 1, bowel 5, appendix 4, peritoneum and omentum 4).

| | | | |
|-----------------------------------|---|---|---|
| Chronic inflammation | 9 | { Chronic inflammation 7 No evidence of carcinoma 1 Columnar-celled carcinoma, but tissue suggests normal intestinal mucosa 1 | |
| Adenoma | 1 | Normal epithelial tissue | 1 |
| Columnar-celled carcinoma | 6 | { Columnar-celled carcinoma 3 Spheroidal-celled carcinoma 3 | |
| Spheroidal-celled carcinoma | 2 | Spheroidal-celled carcinoma | 2 |
| Carcinoma of appendix | 1 | Malignant tumour, ? round-celled sarcoma | 1 |
| Spindle-celled sarcoma | 1 | Spindle-celled sarcoma | 1 |
| Tuberculosis plus sepsis | 1 | Tuberculosis plus sepsis | 1 |

It was not always found possible to diagnose correctly on the film whether a carcinoma was columnar- or spheroidal-celled. The sections of the columnar-celled carcinomata examined usually showed areas of the spheroidal-celled type of growth, and frequently in the film the spheroidal-celled portion only was recognized. A carcinoma of the appendix, without a knowledge of its origin, was diagnosed as 'a malignant tumour, possibly a round-celled sarcoma'. The case of diverticulitis diagnosed as a carcinoma is referred to in detail on page 254.

Table II.—RESULTS IN DETAIL, *continued*.

F. BREAST (54 Cases).

| SECTION DIAGNOSIS | | | | NO. OF CASES | FILM DIAGNOSIS | | | | NO. OF CASES |
|-----------------------------|--|--|--|--------------|---|--|--|--|--------------|
| Spheroidal-celled carcinoma | | | | 37 | Spheroidal-celled carcinoma | | | | 37 |
| Chronic mastitis | | | | 7 | Chronic mastitis | | | | 7 |
| Galactoecele | | | | 1 | Galactoecele | | | | 1 |
| Fibro-adenoma | | | | 3 | { Atypical carcinoma Spheroidal-celled carcinoma | | | | 2 1 |
| Tuberculosis | | | | 1 | Non-malignant, giant cell present | | | | 1 |
| Fibrosarcoma | | | | 1 | Fibroma | | | | 1 |
| Duct papilloma | | | | 2 | { Duct papilloma Adenomatous tissue | | | | 1 1 |
| Acute infective mastitis | | | | 1 | Acute infective mastitis | | | | 1 |
| Spindle-celled sarcoma | | | | 1 | Spindle-celled sarcoma | | | | 1 |

In *Table II F* the full record is given of 54 breast cases which were examined by this method. Out of the total, there were 44 cases of carcinoma and chronic mastitis which were diagnosed correctly in every instance, this being a most important practical application of the rapid method. About a dozen of these cases were examined while the surgeon awaited with an anæsthetized patient to decide the mode of completion of the operation. The errors made in this section are discussed in detail on page 254.

G. LYMPH GLANDS (59 Cases).

| | | | | | | |
|-----------------------------|----|----|------------------------------------|----|---|--|
| OF LIPID GLANDS (52 Cases). | | | | | | |
| Squamous-celled carcinoma | .. | 14 | { Squamous-celled carcinoma .. | 11 | | |
| | | | { Spheroidal-celled carcinoma .. | 1 | | |
| | | | { No evidence of malignaney .. | 2 | | |
| Spheroidal-celled carcinoma | .. | 10 | { Spheroidal-celled carcinoma .. | 8 | | |
| | | | { Carcinoma .. | 1 | | |
| | | | { No evidence of carcinoma .. | 1 | | |
| Melanotic carcinoma | .. | 1 | Melanotic carcinoma | .. | 1 | |
| Basal-celled carcinoma | .. | 1 | Basal-celled carcinoma | .. | 1 | |
| Carcinoma | .. | 1 | Chronic lymphadenitis and necrosis | .. | 1 | |
| No evidence of carcinoma | .. | 19 | { No evidence of carcinoma .. | 18 | | |
| | | | { Carcinoma, scattered .. | 1 | | |
| Chronic inflammation | .. | 5 | Chronic inflammation | .. | 5 | |
| Tuberculosis | .. | 4 | Tuberculosis | .. | 4 | |
| Alveolar sarcoma | .. | 1 | Spheroidal-celled carcinoma | .. | 1 | |
| Perithelioma | .. | 1 | Malignant growth | .. | 1 | |
| Lymphadenoma | .. | 2 | Lymphadenoma | .. | 2 | |

Table II.—RESULTS IN DETAIL, *continued*.

In the above 59 cases carcinoma was found in the section in 3 cases where none had been found in the film; in each case the deposit was a small islet. Conversely, in one case, that of a gland from the axilla secondary to a carcinoma of the breast correctly reported on by the film method, scattered carcinoma cells were found in the film, but none were seen in the gland at the level the section was made. This discrepancy is only to be expected, as a small deposit of carcinoma in a gland is as likely to be missed by one method as the other.

The 19 cases referred to as 'no evidence of carcinoma' were all glands examined specifically for secondary growth, and showing no gross abnormality.

II. GENITO-URINARY SYSTEM (18 Cases : kidney 6, prostate 7, bladder 1, uterus 3, ovary 1).

| SECTION DIAGNOSIS | NO. OF CASES | FILM DIAGNOSIS | NO. OF CASES |
|-----------------------------------|--------------|---|--------------|
| Hypernephroma | 2 | { Hypernephroma Malignant tumour, probably carcinoma | 1 1 |
| Columnar-celled carcinoma .. | 1 | Carcinoma, villous type | 1 |
| Adeno-carcinoma | 2 | Spheroidal-celled carcinoma .. | 2 |
| Carcinoma, showing giant cells .. | 1 | Spindle-celled sarcoma | 1 |
| Squamous-celled carcinoma .. | 1 | Squamous-celled carcinoma | 1 |
| Sarcoma, cylindroma type .. | 1 | Sarcoma | 1 |
| Adenoma | 5 | Adenoma | 5 |
| Myxoma | 1 | Myxoma | 1 |
| Fibroma | 1 | Simple connective tissue | 1 |
| Inflammatory | 3 | Inflammatory | 3 |

The case diagnosed as a spindle-celled sarcoma was a bladder tumour showing many large multinucleated giant cells and what were regarded as spindle-shaped sarcoma cells; the paraffin section showed it to be a transitional-celled carcinoma with giant cells present.

SURVEY OF METHOD.

We wish to emphasize that this method of fixation provides a very beautiful method of demonstrating the appearances of malignant and other cells, showing the structural details of the individual cells in a manner not seen in the corresponding sections. This is explained by the perfect fixation which is obtained of the wet cell in Schaudinn's fluid.

Appearances of Cells.—We have found that, in general, malignant cells appear larger than the corresponding normal epithelial or connective-tissue cells; the nucleus is frequently excentric, and occupies a larger proportion of

the whole cell. A reticular staining of the nucleus, the presence of nucleoli, and mitotic figures are usually clearly seen. The individual malignant cells may vary considerably in size, whereas the film preparations of a simple tumour or of a normal tissue show cells of a regular size and appearance, with small, evenly stained, centrally-placed nuclei.

Arrangement of Cells.—The manner of the breaking up of the cells in the film also depends upon the type of tissue. A normal tissue, if scraped, does not make a good film, because fragments of normal tissue, such as plaques of squamous epithelium, shreds of mucosa showing complete tubular glands, and strands of fibrous tissue occur as isolated masses without intervening cells. Scrapings of a simple tumour, such as an adenoma of the prostate, show the cells in rather smaller clumps than in a scraping of normal tissue. The individual cells are of normal size and appearance, but the complete glandular structure is not seen, and isolated cells are comparatively few. A carcinoma breaks up much more completely: the cells are not only different in appearance, but perhaps half the cells present will be isolated like cells in a blood-film, while only a certain proportion will be grouped in twos, threes, or in small plaques. The stroma of a carcinoma is not usually seen, hence the occasional difficulty in distinguishing a carcinoma from a sarcoma. The cells of sarcomata, as a rule, break apart from one another almost completely, giving a uniform film of cells with few, if any, plaques of tissue.

It is of particular interest that new growths of low malignancy, such as rodent ulcers and parotid tumours, of which we have examined 9 specimens, show in their film histology characters intermediate between the typical carcinomata and the simple tumours. The cells are rather more regular in size, and the nuclei stain darker and more evenly. The film usually shows considerable plaques of tissue as well as large numbers of isolated cells.

Post-mortem Specimens.—We have found the method unsuitable for the examination of post-mortem specimens, in the few cases in which it was tried, owing to tissue autolysis.

CONCLUSIONS.

1. A wet-film method for the examination of new growths and inflammatory tissues is introduced.
2. The technique is very simple, and requires no elaborate apparatus.
3. The time required for the preparation of the microscopical specimen of a tissue removed at operation is from eight to ten minutes.
4. The method is unsuitable for post-mortem specimens.
5. Two hundred cases have been so examined, and 191 correct diagnoses returned.
6. Special experience of this method should be acquired before it is employed in practice.

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RUPTURED URETHRA: A NEW METHOD OF TREATMENT.

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THE following method of treating rupture of the urethra is based on three cases which came under my care in 1924. So far as I am aware, the method has not been described before.

Suprapubic cystotomy is done and a fully curved metal prostatic catheter is passed through the internal meatus along the urethra to the seat of rupture. Another fully curved metal catheter is passed through the external meatus along the urethra until it comes in contact with the first. The two catheters are then taken one in each hand and gently manipulated until their beaks lie in contact with one another, end to end. By gently withdrawing the first catheter and pushing the second one farther in, keeping the beaks in contact, it is possible to guide the second catheter past the seat of the rupture and into the bladder. No force is required. The second catheter is made to protrude through the suprapubic opening and a self-retaining rubber catheter is attached to it by means of a silk thread. The metal catheter is then withdrawn from the external meatus and in this way the self-retaining catheter is drawn into place past the rupture. The opening in the bladder is closed and a small drain placed in the space of Retzius. The patient is given cystopurin and encouraged to drink plenty of water. Each day after the third day the bladder is gently irrigated with boracic lotion to diminish the formation of deposit on the beak of the catheter. At the end of ten days the self-retaining catheter is removed. This may require an anæsthetic.

My three cases have been of a similar nature, each being that of a collier crushed underground, with multiple fractures of the pelvis and rupture of the membranous urethra. In no case had the patient passed urine between the time of the accident and the operation, nor had he attempted to do so, with the result that there was no extravasation of urine. Each was immediately warned not to make the attempt.

With regard to diagnosis, this was made by trying to pass a catheter into the bladder. Failure to accomplish this is the indication for the operation described. A soft rubber catheter should first be tried, and if unsuccessful a medium-sized metal one. The metal catheter gives a better sense of touch and position, and it is sometimes possible to negotiate the rupture with it, particularly in cases of incomplete tear. Bleeding from the external meatus and a swelling in the perineum were constant signs.

In one of my cases in which the violence causing the accident was very severe, on passing a metal catheter for diagnostic purposes the instrument was felt to go in as far as the region of the triangular ligament, when it became

quite free and appeared to be in a cavity, which indeed it was, in front of the bladder; with it could be felt loose bone, and at the subsequent operation it was found that the bladder and prostate had been literally dislocated from the urethra. In spite of loose bone no sepsis occurred and convalescence was uneventful.

Each case got on well and there has been no difficulty during the three years which have elapsed since the accidents, a mild orchitis in one case being the only complication. Operation was performed within three hours of accident.

Since performing this operation I have had made for me by Messrs. Weiss a special catheter. It is made of copper, size No. 8, and, being pliable, it can be bent to a suitable curve. As shown in the illustration (*Fig. 192*) one

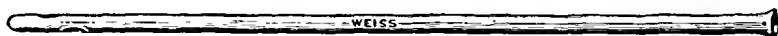


FIG. 192.

extremity is open and slightly bell-mouthed. This enables the point of the catheter introduced through the internal meatus to be more easily engaged. At the other extremity is a small hole to take thread for attaching the self-retaining catheter.

Although it is obvious that accurate conclusions cannot be drawn from so small a number of cases, it appears to me that this method offers the following advantages over opening the perineum: (1) The operation can be performed rapidly: this is of importance, as most of these cases have multiple injuries and suffer from severe shock. (2) There is less formation of scar tissue at the seat of rupture. (3) Drainage of the space of Retzius is provided for, and sepsis does not occur.

THE PATHOLOGY AND TREATMENT OF A VESICAL TUMOUR RESEMBLING AN ENDOMETRIOMA.

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THE common growths of the bladder belong to the epithelial group of tumours, and fall readily into two genera, papillomata and carcinomata. The latter arise either primarily from the squamous cells of the mucous membrane, or secondarily from the papilloma or wart. Examples of the change in the character of the latter are well known in other parts of the human body. Experimentally they have been produced in animals, more especially in rats and mice.

A search in the literature on the subject of vesical tumours has revealed a description of an epithelial lesion which has been termed an adenoma. The definition of an adenoma is that it is a tumour constructed upon the type of, and growing in connection with, a secreting gland. Another characteristic is that it is encapsuled.

The investigator's attention is naturally drawn to the evidence which is available of the presence of secreting glands in the wall of the bladder. Lendorf in 1901 described certain glandular structures around the urethral orifice and at the base, which consist of solid epithelial down-growths and glands with one to five lacunæ draining into a single excretory duct. In the posterior wall of the bladder only the epithelial in-growths are found, and the apex is free from glandular structures. These glands are stated to have a mucus-secreting function, but this is disputed by Egging. Glandular structures have been seen also by Tourneaux and Hartman, Rauber-kopsch, and Zuckerkandl. Jordan and Ferguson state emphatically that the mucous membrane, except in the urethral orifice, contains no glands. In this situation there are a few mucus-secreting glands which are only observed in the male subject and are interpreted as vestigial prostatic tubules. They are not present in children.

From the evidence that has been accumulated it is clear that the internal meatus and base are the only parts of the bladder in which glands can be consistently demonstrated. If glands are so common in other regions as some authorities would have us believe, one would expect to find many more cases of so-called adenomata recorded.

The literature on the subject of these rare tumours is confined to a description of barely twenty cases, some of which, in the opinion of the writer, cannot be claimed as primarily arising from the bladder wall. Thus the notes of the cases given by Bridoux, Geraghty, Uteau, and others, in which the tumours occur in the male sex, and arise either from the base of the bladder or around the internal meatus, lead one to the definite conclusion

that they are prostatic in origin. These tumours, however, correspond to the pathological definition of an adenoma, whereas those described by Rinaldi Cassanello, Saecchi, and De Korte and classed as adenomata, the writer submits cannot be included in that category. The tumour in each of these cases arises from the posterior wall of the female bladder, is not connected with a secreting gland, and is not encapsuled. All the female cases are characterized by severe hæmaturia.

At this point a brief reference to the articles by the three authors named will serve to focus the attention on the main lines of the argument which is being elaborated. Rinaldi Cassanello's patient was a female, age 40, with a normal menstrual history. She had had severe hæmaturia for six months. A neoplasm, the size of a Tangerine orange, was observed on the posterior wall of the bladder close to the right ureteric orifice, and was found to be independent of the uterus. The tumour was removed by an open operation by local excision and was obviously not encapsuled. Recovery was complete. Six months later, nephrectomy for abscess of the right kidney was performed. The author describes the bladder growth as an adenoma, but states there is uncertainty whence it arises.

G. Saecchi records a case of a woman, age 50 years, with severe hæmaturia, due to a smooth broad-based mass the size of a pigeon's egg, beyond the left ureteric orifice, which was excised by open operation. Recovery was good. Histological examination showed that the lesion was an adenoma undergoing cystic degeneration.

Finally, W. E. De Korte describes an operation for the removal of a bladder tumour of the posterior wall in a woman of 56 who had suffered from severe hæmaturia. Three weeks after the operation the patient complained of pain in the right iliac fossa, and at a later date a number of subperitoneal cysts containing mucus were found and evacuated. Death took place in three years. The microscopic sections of the vesical growth demonstrated, according to this observer, an adenoma similar in appearance to a rectal polyp.

There is much similarity in the descriptions of these three cases. All occurred in women, all had severe hæmaturia, all the tumours were removed from the posterior wall, and all were supposed to be adenomata. None of these investigators, on the other hand, suggests from what gland the adenoma arises.

THE AUTHOR'S CASE.

In March, 1923, Mrs. W., age 42, was referred to the writer by Mr. Gordon Luker, late gynecologist to the London Hospital, on account of painless hæmaturia. A piece of tumour had been previously passed per urethram which proved on microscopic examination to consist of columnar cells. Under general anaesthesia a complete examination was made of the pelvic organs. Cystoscopy (*Fig. 193*) showed a tumour the size of a walnut growing from the posterior wall of the bladder and covering the right ureteric orifice. On another part of the posterior wall was a plaque-like swelling the size of a postage stamp.

Dilatation and curettage of the uterus by Mr. Gordon Luker showed no



FIG. 193.—Appearance of tumour before diathermy treatment was commenced.



FIG. 194.—Drawing of a microscopic section of a part of the tumour which resembles the glands of the uterus. ($\times 54$.)

evidence of disease of either the endometrium or interstitial tissue. The writer then proceeded, by means of an open operation and diathermy, to remove the bladder growth together with the adjacent plaque-like mass. The patient's convalescence was uneventful.

Fifteen months later the tumour recurred on the posterior wall, and was destroyed by means of transurethral diathermy. In June, 1926, though the general state of health remained excellent, there was a recurrence of hæmaturia, and again a small tumour was treated with diathermy. Six months later this woman reported an attack of pain in the right loin, with fever, symptoms suggestive of ascending infection up the right ureter due to obstruction of the orifice by growth. This was confirmed by cystoscopy.

It was now clear that the cells of the tumour were becoming resistant to the action of a diathermy current of not more than 10 milliamperes. Recently, by the technique advocated by Frank Kidd, and using his special diathermy cystoscope, a current of 1.7 ampères has been passed through the tumour. Should this treatment fail, recourse will have to be made in the near future to hemicystectomy and transplantation of the right ureter.

The microscopic sections of the growth show a hyperplasia of gland acini, lined with a deep columnar epithelium in a delicate vascular stroma containing numerous small round cells of inflammatory type. The epithelium lining the acini is very regular and is limited by the basement membrane, but there is active proliferation of the cells within the acini. The glands closely resemble those of the uterus. There is no definite evidence of malignancy. Thus this tumour has more of the characteristics of an endometrioma than of an adenoma. Clinically it is similar in every respect to those described by Cassanello, Sacchi, and De Korte.

Brakemann in 1924 recorded the discovery of a tumour the size of a walnut on the posterior wall of the bladder, which was removed during laparotomy for other conditions. No mention is made of the presence of any vesical symptoms, but the pathological report is identical with that of the author, namely, glandular cavities similar to adenomyohyperplasia uteri.

Much attention has been given in recent years by gynaecologists to the pathology of endometriomata. A theory has been put forward by Sampson, Vernon Bailey, and others, that pelvic endometriomata are the result of endometrial grafts due to the back-flow of the menstrual discharge from the uterus through the Fallopian tubes, but this cannot account for their presence between the layers of the broad ligament and having no communication with the peritoneal cavity. Such a case has been described by Beekwith Whitehouse. The latter has also removed an endometrioma from the antero-superior surface of the uterus, which was invading the peritoneum of the utero-vesical pouch and fixed to the bladder. A portion of the bladder wall had to be excised with the tumour, which was found to have no communication with the uterine cavity either macroscopically or microscopically.

The position of these two tumours appears to call for another explanation than that based upon the assumption of endometrial grafts. Support for this view is given by the presence of growths in the bladder which closely resemble uterine tissue and must be classed as endometriomata. In this

situation it is impossible for endometrium from the uterus to graft itself into the bladder wall, and, of all the theories which attempt to explain the origin of these interesting tumours, the acceptance of the peritoneal offers the fewest difficulties. This theory assumes that the epithelial cells of the peritoneum, when they proliferate in response to an irritation, the nature of which is unknown, undergo differentiation *in situ* into uterine epithelium. This will account for endometrial tumours of the intestines, the bladder, the groin, and laparotomy scars.

The subsequent history of De Korte's patient, in which subperitoneal cysts containing mucin were found, demonstrates that, whatever view may be held with regard to the nature of the bladder growth, proliferation of the epithelium of the peritoneum was occurring, which is evidence in support of the theory that the primary tumour was an endometrioma. It is also significant that the four tumours described in female subjects by Cassanello, Sacchi, De Korte, and the writer, were situated on that part of the bladder wall which is covered by peritoneum.

Can the endometrioma be classed as a malignant growth? The writer is of opinion that primarily this tumour, like the vesical papilloma, is innocent, but that, just as in the laboratory the skin wart, by means of the application of certain chemical substances, takes on the characteristics of the squamous-cell carcinoma, so, as a result of a persisting irritation, this rare bladder tumour will also undergo a cancerous change.

SUMMARY.

1. Tumours of the female bladder which have been described hitherto as adenomata must be included in the category of endometriomata.

2. The theory which best explains the origin of these tumours is that a metaplasia of the peritoneal epithelium occurs as a result of a long-continued irritation.

3. In all probability the correct treatment is partial cystectomy rather than an attempt at destruction by the diathermy current.

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VOLVULUS OF SMALL GUT, CÆCUM, AND ASCENDING COLON, ASSOCIATED WITH CONGENITAL REVERSED ROTATION OF INTESTINE AND WITH PREGNANCY.

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NON-ROTATION and mal-rotation of the intestine have been comparatively frequently described, but *reversed* rotation, whereby the cæcum and ascending colon occupy their normal positions but the transverse colon passes behind the small intestine and, or through, its mesentery, is extremely rare. Dott,¹ in his admirable article on the abnormalities of rotation, could only cite two cases, one of his own and one of Hunter's;² Harvey³ has since reported one. The case to be described differs from these both in the abnormality and in the complication.

Embryology.—During early embryonic life there is a temporary herniation into the umbilical cord of the rapidly-growing midgut loop, which comprises that portion of intestine represented in the adult from the duodenum at the bile papilla to the left third of the transverse colon. The base of the loop is narrow, the duodenum being held by the mesoduodenum and the hindgut by a retention band at the colic angle (Frazer and Robbins⁴). The superior mesenteric artery runs down in the loop, dividing it into pre- and post-arterial segments, corresponding to the eventual small- and large-gut portions of the loop.

According to Frazer and Robbins, the normal return of the loop within the abdomen commences with the pre-arterial segment returning first. Because of the liver above, it must pass beneath the distal end of the loop, and behind the superior mesenteric artery. Entering on the right side it meets the median mesocolon and pushes that over to the left. The post-arterial segment now returns and takes up a position anterior to the small gut and the artery. There is thus an anti-clockwise turn of the loop through 270°. The explanation given of the pre-arterial segment returning first lies in the relatively large size of the cæcum, which last to reduce.

In reversed rotation there is a clockwise turn through 90°; arterial segment is believed to reduce first, and thus the transverse to be behind the jejunum and the superior mesenteric artery.

After return of the loop the process of rotation is completed by the cæcum and fixation of parts of the intestine by fusion of the with the peritoneum of the posterior abdominal wall. When of rotation occur, fixation is often deficient, and this was particularly in the case to be described.

Description of Case.—A female, age 27, was admitted to the London Hospital complaining of twenty-four hours' abdominal pain and vomiting, intermittent at first but almost continuous later. She had absolute constipation, and enemata had failed to give relief. She was fully five months pregnant. Her previous history as regards abdominal trouble consisted of one attack of colic lasting three days at the age of 25. She was an epileptic.

ON EXAMINATION.—A very ill patient was seen, with almost continual stercoral vomiting, extreme restlessness, and a rapid, thready pulse. The abdomen was hugely distended and tympanitic all over, save where the uterine dullness rose to just below the umbilicus. That acute obstruction was present was evident, and a diagnosis of volvulus was made because of the rapid and extreme distention.

OPERATION.—Through a low paramedian incision, the presenting small gut was found enormously distended and of a uniform blackish-brown colour. Search for the cæcum in the right iliac fossa proved fruitless. The transverse colon could not be found. Further search revealed the cæcum in the region of the spleen, with the appendix blown out like the finger of a rubber glove. The cæcum and ascending colon, the latter freely mobile on the common mesentery, were brought out of the wound, and on placing the cæcum in the right iliac fossa it could be seen that small gut, cæcum, and ascending colon formed a free loop which had still to be rotated in an anti-clockwise fashion for two full turns before things would be normal;

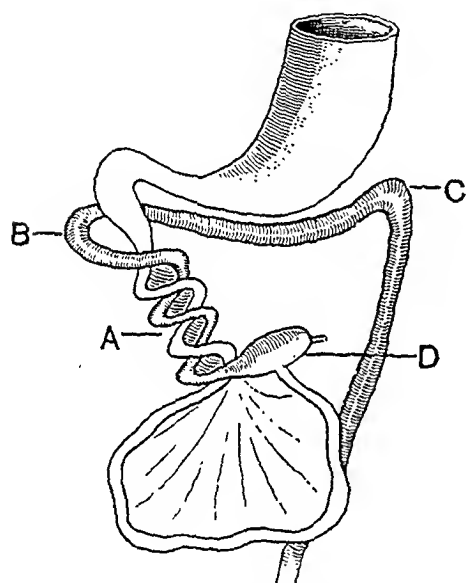


FIG. 195.—Diagram showing twist of two and a half turns of midgut loop in clockwise direction. The retrojejunal position of the transverse colon is also shown. A, Volvulus; B, Hepatic flexure; C, Splenic flexure; D, Cæcum.

that is, the loop had undergone a torsion of two and a half turns clockwise. The torsion was undone, cæcostomy performed, and the operation concluded as quickly as possible because of the low condition of the patient. The diagram (*Fig 195*) indicates the nature of the twist. Death occurred four hours later.

POST-MORTEM.—The anatomical abnormality was clearly revealed. The small gut, cæcum, and ascending colon were all on one mesentery, the attachment of which to the posterior abdominal wall was short and high up in the abdomen. The first point of fixation was at the hepatic flexure, and the loop hung down freely in front of the transverse colon, which was bound by a mesocolon never more than 1 cm. long close to the posterior abdominal wall caudal to the mesenteric attachment. The duodenum lay in front of the

superior mesenteric vessels, the transverse colon behind. The condition after reduction is depicted in *Fig. 196*.

COMMENTS.

The case illustrates well the fact that anomalies of rotation are often accompanied by deficient fixation of the intestine. The narrow pedicle of the midgut loop predisposed to torsion, and it would appear probable that the

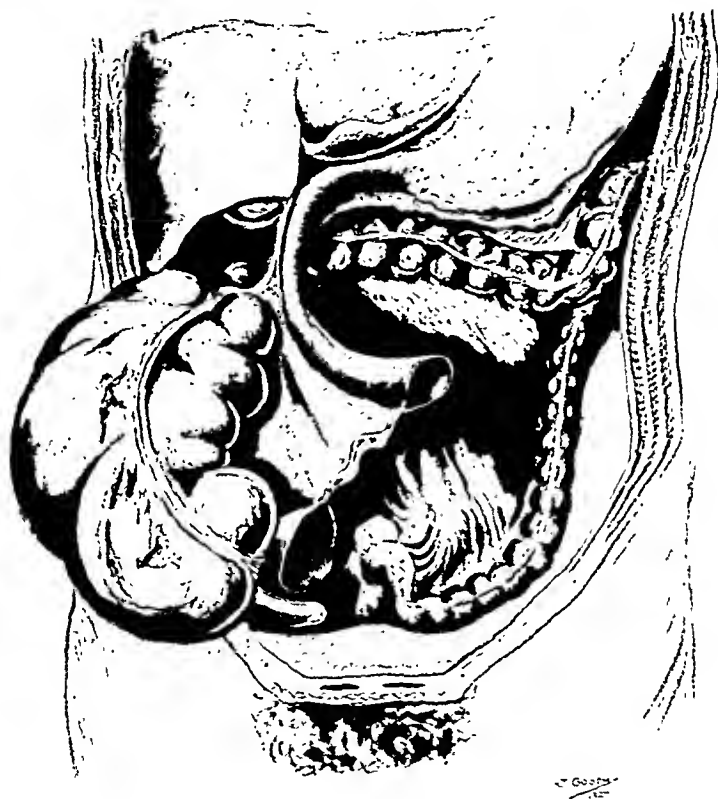


FIG. 196.—Drawing from sketch made at post-mortem. The greater part of the small intestine and the uterus have been omitted for clearness. The retrojejunal position of the colon and the extreme distention are obvious, and by the shading an idea is obtained of the free midgut loop suspended from a narrow attachment above.

enlarged pregnant uterus, by pushing the loop up near its base, was the exciting factor.

Comparison with the three above-reported cases of reversed rotation reveals interesting differences. In Hunter's² case in an infant the abnormality was associated with large mesenteric cysts, and taking the view that these were derived from shut-off diverticula of the small gut he concluded

that they had been present on the pre-arterial segment in the physiological hernia, and thus the relatively smaller post-arterial segment had reduced first. In his case no obstruction was present. In Dott's¹ case, fixation of the mesentery in a man of 68 had occurred below the transverse colon as far as the right iliac fossa, so that the colon passed through an aperture in the mesentery; but the cæcum and ascending colon remained free, and volvulus of these only occurred. In Harvey's³ case the colon of an infant also passed through an aperture in the mesentery, and there was actual obstruction at this point. Thus only in Hunter's case was there an apparent cause for the retrojejunal position of the colon. The present case differs from the others in a greater amount of lack of fixation.

I am indebted to Mr. E. C. Lindsay, under whose care the patient was admitted, for permission to publish this case; to Dr. W. W. Woods, who made the post-mortem examination; and to Professor J. E. Frazer for kind advice.

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ON INJURIES OF THE SEMILUNAR CARTILAGES.

BY C. H. FAGGE,

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NOR the least of the surgical benefactions for which we are indebted to Leeds is Hey's pioneer work on internal derangement of the knee-joint, to which in recent years the large operative experience of the Newcastle surgeons has added much knowledge of great value in diagnosis and treatment. When writing in 1912¹ I was surprised to find that the literature on this subject is almost entirely British, and, as far as I can judge, this is still true. It is strange that recent American surgical writings should contain nothing on knee injuries except records of personal experience by Melvin Henderson² and McGuire³; for a large majority of our cases in the South of England date from football accidents, and one cannot suppose that American football and baseball are less robust or less liable to put abnormal strains on joints than our British varieties. I have tested over and over again Rutherford Morison's⁴ concise and classical account of the initial accident and subsequent history which lead to the diagnosis and, as might be expected, have found it most helpful and entirely accurate except in regard to one or two small points.

If there be any surgical condition in which a diagnosis can be made from the history alone it is, in my opinion, a torn semilunar cartilage, though I would be the first to admit that to this, which is only a relative truth, there are very many well-marked exceptions. In the diagnosis of the cases now under review I have been several times struck with the insignificant nature of the alleged primary accident. For example, a medical man, 50 years of age, twisted his right knee playing tennis in June, 1921, but was able to finish the set; he recalls having acute synovitis of the knee as a medical student, but does not know whether it was the same joint. A loose body could be felt in the joint which on exploration proved to be a long tag of the internal semilunar; since its removal in October, 1921, he has been completely free from disability. Of this there are two possible alternative explanations: either these cases are exceptions to Rutherford Morison's description of a well-marked, fairly severe injury immediately followed by effusion, or, as appears more probable, the real causative injury had taken place some years previously and had been entirely forgotten.

Morison has commented on the fact that when the fracture is of the bucket-handle variety the patient does not give the typical history of recurrent disability with effusion from slight injuries, alternating with intervals of varying duration of complete freedom, but is continuously disabled by pain, effusion, locking, or a sense of insecurity in the joint. I am unable to confirm this observation, for, with few exceptions, all my cases of bucket-handle fracture of the internal semilunar complained of recurrent disability with

intervals of complete freedom, and in some cases these intervals were of many years' duration. It may be that in such cases the strip lateral to the line of fracture is only rarely displaced into the intercondylar notch, but usually lies alongside the thicker attached fragment from which it has been torn, and, on the other hand, that when the lateral strip lies constantly in the intercondylar notch continuous disability results. This is obviously incapable of proof, for in an operation on a patient with an intermittent history the finding of a bucket-handle fracture of the internal semilunar with the lateral strip displaced into the intercondylar notch is no proof that the displacement has been constant, though on the other hand, as in one of my cases (G. B.), the discovery of the torn strip lying in its natural position does provide a hypothesis for the intermittent history of these cases and is for other reasons a clinical observation of extreme importance. (I have applied the term bucket-handle fracture to the actual conformation of the initial lesion and not to its subsequent displacement, which seems to me of secondary importance. It may be that I have used this term in a slightly different sense from that in which it was used by Morison, and therefrom have misconstrued his argument.)

Some writers have laid stress in diagnosis on the presence of localized tenderness below and medial to the patella. With this I can agree, but when it is further stated that the injured cartilage can be felt at this spot and rolled under the finger, my operative experience leads me to protest that in a large majority of the torn cartilages which I have exposed it is physically impossible for the cartilage to be palpable. It seems that both tenderness and a palpable mass indicate a swollen synovial fringe which is the expression of synovitis resulting from the loose body in the joint, for I have found such fringes on opening the joint whenever it has been suggested before operation that a torn cartilage was to be felt. In my opinion locking is of no value in differential diagnosis; it is usually present in these injuries, but is equally common in any other form of loose body.

The discussion at the Royal Society of Medicine in 1912 probably brought home to surgeons the fact that no satisfactory explanation of the exact mechanics of the injury had yet been thought out, for Walton⁵ tried to prove that the cartilage was fractured in 'full extension', but did not suggest how this is brought about beyond expressing the opinion that the cartilage is "caught between the two bones and subjected to a very powerful crushing force which is liable to fracture" it.

Martin,⁶ speaking at the same meeting, laid stress on an 'inward twist' as the chief factor, but he does not give his view of the exact mechanics of the injury, though shortly afterwards he emphasizes a most important point when he draws attention to the close connection of the internal semilunar with the capsule and internal lateral ligament. It is curious that the obvious inference escaped him, for he says, "If the cartilage be nipped between the internal condyle and inner tuberosity of the tibia and *dragged towards the centre of the joint*, . . . a split or tear would result". It appears impossible that the outer border of the semilunar should be fixed, and yet at the same time the whole cartilage should be dragged laterally; there is no appreciable force for this lateral drag except a sucking of the cartilage towards the centre of the joint, which only occurs in abduction when

the outer free border of the internal semilunar cartilage cannot be nipped. In order to tear the semilunar cartilage longitudinally it is obviously necessary to separate its lateral borders; if the outer border is nipped and cannot therefore move, it is plain that the tear takes place by reason of the inner border being drawn inwards, which is an exact opposite to Martin's hypothesis: this is brought about by extension, or an effort to extend by which the internal lateral ligament is tightened, and so drags the internal semilunar cartilage *inwards* with it, i.e., *away from the centre of the joint*. May this not be the compromise between the opposing views of the two surgeons quoted?

It would appear to me that it does not matter whether the joint is in a position of slight or considerable flexion provided it is also abducted, for this allows of the internal semilunar being drawn towards the centre of the joint while the internal lateral ligament is slack; but in my own view it is essential that from such a position of flexion the joint must be gradually extending at the moment the fracture occurs. Former writers have attributed to rotation at the knee-joint a great part in the causation of this injury; but while it is true that many patients volunteer information that their disability began with a twist of the joint, it is difficult to understand how rotation can be a factor of first importance in the mechanics of this injury, nor, if what is written above is correct, is it necessary to invoke its aid.

It appears to me that the sequence of events is as follows: A young man playing Rugby football has just transferred most of his weight from one leg, say the left, to the right; he suddenly swerves to the right, and in doing so throws his body-weight outside the axis of the right leg so that the right knee is abducted. By this action the internal semilunar is sucked towards the centre of the joint so as to fill up the space which is formed; the knee, though somewhat flexed, is being extended, and it may be that in swerving he also turns to the right or left, thus rotating the femur outwards or inwards; this rotation fixes the outer free thin border of the semilunar, and as by gradual extension of the knee the inner thick attached border of the cartilage is drawn away from the centre of the joint, owing to its firm fixation to the internal lateral ligament, which is becoming tense, the cartilage splits longitudinally between these opposing forces.

I have attempted to work out a mechanical basis for the production of bucket-handle fractures only, for my experience of these is larger than of other types: it may be that this type is primary to all others, i.e., after the cartilage is torn longitudinally a twist continues the line of fracture to the lateral concave margin, and so a tag free in front or behind is produced.

I can scarcely pretend that the above hypothesis is original, for most of the factors concerned have been employed by other surgeons in their explanations, but in some particulars it differs from, and goes further than, the description of others, and as a whole I have not read it elsewhere.

No correct idea of the pathology and causation of this injury is to be anticipated unless the anatomical details of the lesion are accurate. The observation of Morison that the cartilage is always torn and never bodily detached from the capsule is therefore of the greatest importance, though even at the present date many surgeons write and speak of 'detachment'. In

the writer's experience of bucket-handle fractures, to the consideration of which this paper is largely confined, the tear is usually situated within an eighth of an inch of the inner thick attached base of the cartilage; for the almost invariable choice of this position no anatomical or mechanical explanation can be offered. There is only one variety of semilunar injury to which the term 'detached' can be truly applied, and this is the rare lesion of the posterior part of the external semilunar, of which one instance was recorded by the writer in 1912; it was first described by Sir Robert Jones as a snapping knee (*genou à ressort*), in which a loud noise is caused by the escape of the cartilage from between the articular surfaces. The writer's experience, admittedly small, suggests two curious features: (1) That it always occurs in girls; and (2) That, as there is no history of injury, the lesion may be due to some anatomical defect: it is suggested that this predisposing defect is an unduly wide extension of the postero-lateral gap in the attachment of the external semilunar cartilage to the capsule. Normally this gap is only sufficient to allow for the passage of the tendon of the popliteus, which lies upon the edge or base of the cartilage with the intervention of a bursa communicating with the knee-joint. If this postero-lateral lack of support of the external semilunar were abnormally wide, undue mobility of the cartilage must result, and its displacement into the intercondylar notch is only a question of time.

These cases are not common, and are so important that a typical example is worth recording:—

E. B., age 13, had complained of occasional attacks of pain in the left knee for at least seven years; at that time it was suggested by a doctor that an injured cartilage might be at fault. Four years ago the joint was swollen and was immobilized in plaster for three weeks; distention with fluid had occurred several times. Three weeks before I saw her in 1926 her knee gave way when walking and she fell; the next day the joint was swollen, and still gave a sense of insecurity at the time of my examination. The joint frequently locks in about 10° of flexion; this can be readily brought about by the patient by a kind of trick movement which is associated with a sharp noise, and locking having occurred the knee cannot be fully extended. She can as easily release the loose body, when a similar noise is audible. On the date of examination the patient had been unable to unlock the knee for several days, but this was easily done by passive adduction and rotation in the fully-flexed position. The diagnosis of displacement of the posterior part of the external semilunar into the intercondylar notch was verified by operation on Nov. 15, 1926. A thin layer of fatty connective tissue appeared to be the only bond between the posterior half of the cartilage and the capsule; almost the whole of the cartilage was removed, and there has been so far no recurrence of the disability.

My Registrars, Messrs. Doherty and Laver, have analysed the notes of my last 19 cases; their number is so small that it is obviously unsound to make statistical deductions from them. I have already drawn attention to the case of G. B., in which the two halves of the torn cartilage lay in their normal position side by side; this case is an admirable example of the necessity in the surgery of the knee-joint for the same freedom of exposure that I was

privileged to learn from Arbuthnot Lane thirty years ago in the surgery of the abdomen. I am confident that in times past I must often have overlooked a bucket-handle fracture from not having realized that the torn strip might be lying in its normal position, and I have not infrequently felt that others operating upon the knee scarcely gave themselves a fair chance of success owing to the extremely limited incision which they employed. A curved skin incision lying parallel to and half an inch outside the inner border of the articular surface of the internal condyle can be carried downwards and inwards until over or beyond that internal lateral ligament, and upwards into the vastus medialis; in the latter direction it may be prolonged to any desired extent, so that the patella may be dislocated outwards and the joint explored. As the aponeurotic layers are cut through below, the internal lateral ligament is identified and carefully preserved; I have never dared, or thought it necessary, to dissect this up from the tibia as practised by the late Mr. Kellock. A four- or five-inch division of the synovial membrane is ample to ensure that no lesion will be overlooked; as a rule, in a bucket-handle fracture, the torn strip is found in the intercondylar notch, but if no lesion is found to account for the disability, abduction of the joint may disclose this strip lying in its normal position, though attached only in front and behind.

This anterior attachment is very carefully cut through so as to leave no projecting roughness which might later give trouble; but the posterior attachment does not need such careful trimming off, as a projection in this position cannot cause locking. Except in very few cases of semilunar injury I have not found it necessary to attempt to remove the whole cartilage. If no lesion of the cartilage is discovered, the joint is closed. I have on a few occasions, but not for over ten years, removed a synovial fringe which has appeared to be thickened; I do not now regard this as a primary condition, and the change is usually general. Removal of such fringes has led to no successes in my hands.

The synovial membrane is now brought together with a continuous suture of Lukens No. 1 iodized catgut, beginning at the top of the incision; when the lower margin is reached, the suture is continued into the aponeurotic layers from below upwards and tied to the beginning of the synovial suture; this I regard as important, for the only vessels cut during the operation (anastomotic connections between the anastomota and the superior internal articular) lie between these two layers and are secured by the above means. Otherwise, owing to the use of the tourniquet, the vessel cut will not bleed during the operation, and being easily overlooked may give rise to a post-operative hæmarthrosis.

The insertion and tying up of this suture is done by instruments only, as part of the Lane technique which is employed throughout. Over abundant dressings a whole roll of wool is wound and secured by a domette bandage applied as tightly as possible; the tourniquet is then removed.

It is perhaps fortunate that this operation is usually called for in healthy young men who bear pain well, for it certainly is followed by more pain than the majority of common operations. Aspirin is given freely, and even three or four morphia injections may be necessary during the first forty-eight hours

for the relief of pain in preference to disturbing the dressing in any way. The limb with the knee slightly bent is supported on pillows, but in spite of this the leg usually swells.

Since applying the dressing in the way just described I have seen no case of post-operative hæmarthrosis, but some ten years ago I had to re-open a knee and wash out much sterile clot.

The commonest ill-effect has been wasting of the vastus medialis; this brought the operation into some discredit during the War, as boards were fearful of returning such men to the line; it usually clears up after two or three months have elapsed from the date of operation, but, even if apparent to the eye, causes no functional disability. The patient moves his knee when and as much as he wishes; passive movements are absolutely barred; he is up and walking in seven to ten days, when massage of the quadriceps is begun.

I think that in every case in which I have found a gross lesion the result has been good. In this series are included three Guy's men whom I recently saw playing together in a match twenty, eight, and seven months after operation; their joints were unsupported and no disability resulted.

It is my custom to regard the diagnosis of torn semilunar in a patient over 30 with the utmost suspicion; yet among these 19 cases 2 were over 50; the eldest, a man of 64, who earned his living pruning vines, explained that unless operation would enable him to climb ladders in safety his livelihood was gone. He had suffered from continuous disability for six months owing to a bucket-handle fracture, and removal of the strip from the intercondylar notch has enabled him to return to his former work.

In middle-aged men the diagnosis from a chronic arthritis of the osteoarthritic type has been of much difficulty, and particularly as the arthritis may be secondary to a torn cartilage. Operation on an arthritic joint which discloses no causal lesion has, in my experience, been followed by exacerbation of all symptoms, and from the point of view of function and wage-earning capacity has proved a major surgical calamity.

The following summary includes every case during the period under review in which the knee has been explored for a supposed semilunar injury; in every case a gross lesion has been verified and demonstrated to others.

Cases: Males 18, females 1.

Age incidence: Under 20 years, 3; under 30 years, 10; under 40 years, 2; under 50 years, 1; under 60 years, 1.

Semilunar injuries: Internal 18, external 1.

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ACCESSORY BREASTS IN THE LABIA MAJORA.

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ACCESSORY breasts are not uncommon in both males and females. They occur with and without nipples. Usually there is one or a pair, but up to nine have been recorded by Hirst.¹ Generally they occur in a line from the anterior axillary fold to the inguinal region, but cases have been recorded of accessory breasts on the shoulder, back, buttocks, or thighs. Cases of four and six breasts have been observed frequently, usually in pairs, situated above or below the normal site. In women, accessory breasts have attracted attention for the first time during pregnancy or lactation by the increase in size and secretion of milk. Until such times the rudimentary nipple has been mistaken for a mole. In some cases there has been no nipple. Smeddon² reported a case of a woman who had an accessory breast in each axilla. The tumours had no nipples or external openings, and no connection with the normal breasts. After parturition they increased in size and then disappeared in five weeks. The tumours had appeared at former confinements, and were among the first signs of pregnancy. In a few instances polymastia appears to be hereditary.

The explanation of the usual site of occurrence is not settled, but the view widely held is that, in the progenitors of man, breasts were present in a line from the axillæ to the groins, and that, as the change from multiple to single offspring took place, there was a gradual diminution in the number of breasts until only two developed normally.

The *Tarsius spectrum*, in addition to pectoral glands, has an inguinal pair, and cetaceous animals have inguinal glands.

Breasts in the labia have been recorded by De Blazio,³ Hartung,⁴ and J. W. Bell.⁵ In De Blazio's case they were bilateral, and each had a nipple. Up to the age of puberty, only the nipples were observed, the glands developing later, and only reaching their maximum size when the woman became pregnant. Hartung's case was in a woman of 30 who was suckling an infant, and Bell's case was in a woman past the menopause. The following case appears to be the first recorded in this country.

Mrs. M. J., a multipara, age 34, was admitted to hospital in October, 1923, for hypertrophy of the right breast. For nine months the breast had been enlarging and causing severe shooting pains. It was twice the size of the left one, which was also larger than normal. On palpation the breast was nodular, and the condition was thought to be a proliferating cystadenoma. It was removed on account of its size and its rapid growth.

Pathologically it was reported as hypertrophic breast tissue. In 1924 the patient returned to have the left breast removed on account of its large size and weight. This was done, and the pathological report was that the condition was an adenocarcinoma.

In May, 1926, the patient, who was five months pregnant, noticed a small lump on the left side of the chest in the situation of the scar. This lump was gradually increasing in size, and a second lump had appeared above and towards the axilla on the same side. A third lump appeared on the right side of the chest near the scar on that side. These tumours were diagnosed as breast tissue which had escaped removal at the previous operations, and they were enlarging with the pregnancy. They were not attached to the skin, nor

were they fixed to the chest wall. The consistency was that of breast tissue. The operation scars were sound, and no nodules were seen in or near them to suggest new growth. The three tumours were removed, and presented the appearance of breast-like tissue with definite capsules. Pathologically they were reported to be fibro-adenomata of the breast.

In July, 1926, the patient noticed a lump in each labium majus, the left one being larger than the right. As they were increasing in size, the question of their removal before labour arose. It was decided to remove them afterwards, as they were outside the vagina. Delivery was easily accomplished at the end of September.

The patient returned in November, 1926, because the



FIG. 197.—Accessory breasts. Stained Sudan III. Red stain shows large fat globules in acini, indicative of active lactation; blue stain, secretory epithelial lining.

tumours were increasing in size and were painful. On admission there was a tumour in the left labium majus posteriorly, the size of an orange. It was attached to the skin, but moved on the tissues deep to it. Below it was a smaller lump apparently separate. Both were soft in consistency and painful when pressed. The skin over the larger one was ulcerated in two places on its under surface from pressure. The right labium majus also presented a tumour the size of a tangerine orange, similar to those on the left side. The inguinal glands were not enlarged.

The lump in the right labium was dissected out first; it possessed a capsule which separated easily from the underlying tissues. The tumours on the left side were then dissected out, and found to be connected, the upper larger portion being encapsuled, the lower smaller portion consisting of three

or four processes burrowing into the perineal muscles. In removing the lower part it was noticed that milky fluid escaped from the cut surface. The skin wounds healed by first intention.

Microscopical examination of the tumours by Mr. Barnard showed that both consisted of actively lactating breast tissue, the milk in the acini and ducts being clearly demonstrated. (*Figs. 197, 198.*)

There were no signs of nipples on either tumour, or signs of accessory breasts elsewhere.



FIG. 198.—Accessory breasts. (a) Fat; (b) proliferating acini; (c) connective tissue.

The patient's pregnancies have been as follow: 1907—child alive; 1910—stillborn; 1915—child alive; 1916—child died at 10 years of age; 1919—child alive; October, 1926—child alive. As regards menstruation, since November, 1926, three periods have occurred, each with very slight loss.

PRESENT STATE.—Patient is now (September, 1927) quite well; there is no swelling in labia or elsewhere, scars are healthy. She is not pregnant.

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A NOTE ON THE GLUCOSE ENEMA AND ITS VALUE IN POST-OPERATIVE TREATMENT.*

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THIS research was undertaken to demonstrate: (1) Whether glucose is absorbed from the rectum in sufficient quantities to make the glucose enema of clinical value; (2) The place of the glucose enema in the treatment of post-operative shock.

In order to ascertain the amount of glucose absorbed by the rectum, glucose enemata were given to two series of patients: (A) *To fasting normal men*; and (B) *To fasting diabetics*.

PROCEDURE.

Fifty to eighty grammes of glucose were given in 500 c.c. of saline or water. The enema was administered by the ward sister at 9 a.m., the patients having been starved since 6 p.m. the previous evening. The blood-sugar was estimated previous to the administration of the enema, and at half-hourly intervals subsequently for two and a half hours. The blood used for this

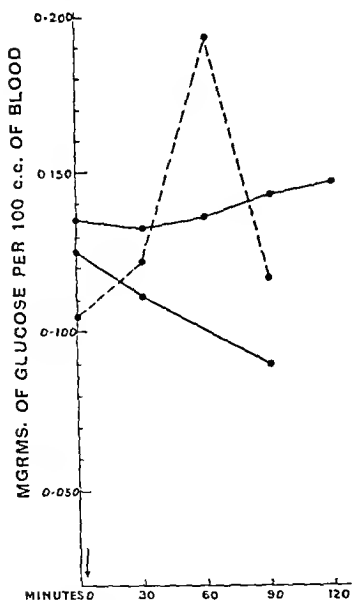


FIG. 199.—Two curves illustrating the changes occurring in the blood-sugar subsequent to the administration of 80 grm. of glucose in 500 c.c. of water by the rectum to two normal fasting men. The broken line shows the curve obtained after the ingestion of the same quantity of glucose by the mouth. Glucose was administered at the point indicated by the arrow.

purpose was obtained by venepuncture and was oxalated, MacLean's technique being employed, and each point of each curve is the mean of two separate estimations.

A. Fasting Normal Men.—The curves obtained in this manner from the estimation of the blood-sugar of 16 normal men are appended. In 11 instances the blood-sugar rose, the maximum rise

* From the Surgical Unit, St. Mary's Hospital.

being 0.069 mgrm. per 100 c.c. of blood at the end of one hour and ten minutes. The average rise was 0.024 mgrm. per 100 c.c. of blood. In 5 instances the blood-sugar fell, the maximum fall being 0.035 mgrm. per 100 c.c. of blood and the average fall 0.027 mgrm. per 100 c.c. of blood. Of the 16 cases under consideration in this section, the mean result was therefore a rise of 0.008 mgrm. per 100 c.c. of blood. Rather similar results in a series of 8 cases were recorded by Tallerman¹ in 1920. This small rise of 0.008 mgrm. per 100 c.c. of blood stands in strong contrast to the rise of 0.085 mgrm. per 100 c.c. which occurred when 80 gm. of sugar were given by mouth to normal fasting men (*Fig. 199*).

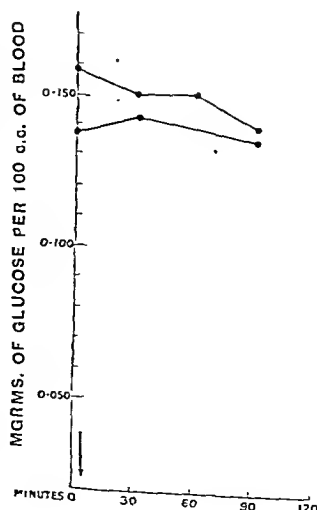
Table I.—NORMAL FASTING MEN.

| PATIENT'S NUMBER | FASTING BLOOD-SUGAR | NUMBER OF HOURS AFTER ADMINISTRATION OF GLUCOSE PER RECTUM | | | | | RISE | FALL |
|---------------------|------------------------|---|-------|-----------------|-------|-----------------|-------|-------|
| | | $\frac{1}{2}$ | 1 | 1 $\frac{1}{2}$ | 2 | 2 $\frac{1}{2}$ | | |
| 1 | 0.086 | 0.083 | .. | 0.094 | .. | .. | 0.008 | .. |
| 2 | 0.106 | 0.079 | .. | 0.103 | .. | .. | .. | 0.025 |
| 3 | 0.070 | 0.081 | .. | 0.000 | .. | .. | 0.020 | .. |
| 4 | 0.065 | 0.084 | 0.090 | 0.099 | .. | .. | 0.024 | .. |
| 5 | 0.097 | 0.092 | .. | 0.083 | .. | .. | .. | 0.014 |
| 6 | 0.106 | 0.082 | 0.121 | .. | .. | .. | 0.020 | .. |
| 7 | 0.122 | .. | 0.115 | 0.115 | 0.152 | 0.158 | 0.036 | .. |
| 8 | 0.060 | 0.098 | 0.125 | 0.129 | 0.097 | .. | 0.069 | .. |
| 9 | 0.096 | 0.111 | 0.120 | R | .. | .. | 0.024 | .. |
| 10 | 0.125 | 0.116 | 0.090 | R | .. | .. | .. | 0.035 |
| 11 | 0.082 | 0.117 | 0.103 | R | .. | .. | 0.035 | .. |
| 12 | 0.134 | 0.146 | 0.127 | 0.134 | .. | .. | 0.012 | .. |
| 13 | 0.096 | 0.078 | 0.096 | 0.085 | .. | .. | .. | 0.028 |
| 14 | 0.164 | 0.131 | 0.135 | 0.139 | .. | .. | .. | 0.033 |
| 15 | 0.122 | 0.122 | 0.132 | 0.134 | 0.126 | .. | 0.012 | .. |
| 16 | 0.136 | 0.133 | 0.136 | 0.144 | 0.148 | .. | 0.012 | .. |

R = Enema returned.

B. Fasting Diabetics.—In this group curves were obtained from the estimation of the blood-sugar of 8 diabetics, the procedure being the same as in Series *A*. In 5 instances the blood-sugar fell and in 3 it rose, the maximum fall

FIG. 200.—Two curves illustrating the changes in the blood-sugar after the administration of 80 gm. of glucose in 500 c.c. of water by the rectum to two fasting diabetics. Glucose enema was administered at the point indicated by the arrow.



being 0.065 mgrm. per 100 c.c. whilst the average was 0.038 mgrm. per 100 c.c. of blood. The mean was a fall of 0.020 mgrm. per 100 c.c. of blood. (*Fig. 200.*)

Table II.—FASTING DIABETICS.

| PATIENT'S NUMBER | FASTING BLOOD-SUGAR | NUMBER OF HOURS AFTER ADMINISTRATION OF GLUCOSE PER RECTUM | | | | | RISE | FALL |
|---------------------|------------------------|---|-------|-------|-------|----|-------|-------|
| | | $\frac{1}{2}$ | 1 | 1½ | 2 | 2½ | | |
| 1 | 0.134 | 0.146 | 0.137 | 0.116 | 0.138 | .. | 0.012 | .. |
| 2 | 0.300 | 0.236 | 0.228 | 0.236 | .. | .. | .. | 0.062 |
| 3 | 0.207 | 0.204 | 0.178 | 0.182 | .. | .. | .. | 0.029 |
| 4 | 0.300 | 0.298 | 0.300 | 0.290 | .. | .. | .. | 0.002 |
| 5 | 0.157 | 0.150 | 0.150 | 0.140 | .. | .. | .. | 0.017 |
| 6 | 0.237 | .. | 0.189 | .. | 0.187 | .. | .. | 0.059 |
| 7 | 0.137 | .. | 0.143 | .. | 0.135 | .. | 0.006 | .. |
| 8 | 0.205 | .. | 0.207 | R | .. | .. | 0.002 | .. |

R = Enema returned.

Post-operatives.—A series of 10 patients, the subjects of operative surgical procedure, was here investigated. The blood-sugar was estimated both before, and periodically after, operation. In every case it rose, the maximum rise being 0.085 mgrm. per 100 c.c. and the mean rise 0.032 per 100 c.c. It was noticed that the longer was the anæsthetic and the greater

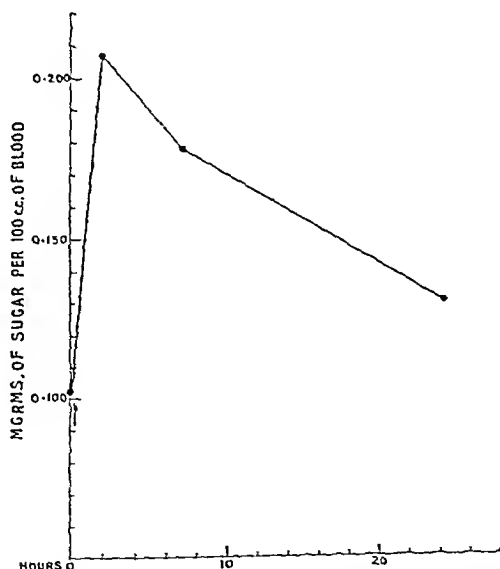


FIG. 201.—The changes occurring in the blood-sugar subsequent to a gastro-enterostomy. Operation at the point indicated by the arrow.

the severity of the operation, the longer the blood-sugar took to return to its pre-operative level. The body, therefore, in the state of 'post-operative shock'—using the term to signify the exhausted condition of the patient after a surgical operation—is permeated with blood containing an excess of sugar which the tissues seem to be unable to utilize. (Fig. 201.)

Table III.—POST-OPERATIVES.

| PATIENT'S NUMBER | FASTING BLOOD-SUGAR BEFORE OPERATION | HOURS AFTER OPERATION | | | | | | | | | | OPERATION | R.F.E. |
|---------------------|---|-----------------------|------|------|------|------|------|------|------|------|------|------------------------------|--------|
| | | 1 | 2 | 3 | 7 | 8 | 12 | 24 | 36 | 48 | 72 | | |
| 1 | ·148 | ·188 | ·132 | .. | ·156 | .. | .. | ·182 | .. | .. | .. | Gastrectomy | ·040 |
| 2 | ·141 | .. | ·195 | .. | ·193 | ·190 | ·185 | ·190 | ·198 | ·181 | ·162 | Duodenectomy | ·051 |
| 3 | ·168 | ·204 | ·177 | .. | ·162 | .. | .. | ·162 | .. | .. | .. | Excision of lip | ·036 |
| 4 | ·148 | ·158 | .. | .. | .. | .. | .. | ·131 | ·141 | .. | .. | Removing plate from femur | .. |
| 5 | ·122 | ·207 | .. | .. | ·168 | .. | .. | ·140 | .. | .. | .. | Gastrojejuno- stomy | ·010 |
| 6 | ·126 | .. | .. | ·157 | .. | .. | .. | ·153 | .. | .. | .. | Cholecystec- tomy | ·085 |
| 7 | ·128 | .. | .. | ·156 | .. | .. | .. | .. | .. | .. | .. | Gastro-entero- stomy | ·029 |
| 8 | ·104 | ·144 | .. | .. | .. | .. | .. | ·104 | .. | .. | .. | Laparotomy | .. |
| 9 | ·112 | ·115 | .. | .. | .. | .. | .. | .. | .. | .. | .. | Varicose veins | ·028 |
| 10 | ·137 | ·125 | .. | ·143 | .. | .. | .. | .. | .. | .. | .. | Gastrogastro- stomy | ·040 |
| | | | | | | | | | | | | | ·003 |
| | | | | | | | | | | | | | ·006 |

CONCLUSIONS.

From the above experiments it is obvious that the rectum and colon vary in their power of absorbing glucose in different subjects; on the whole the rate of absorption is slow, and very little sugar can, apparently, be introduced into the body by this route.

From the practical point of view, rectal glucose would appear to be of little value as a means of maintaining bodily nutrition, and from the above series of estimations it appears to be fortuitous whether absorption occurs at all.

Finally, individuals the subjects of post-operative shock are in a state of hyperglycemia and seem to be unable to utilize sugar normally, although their tissues are bathed in a fluid containing an excess of this substance. A glucose rectal saline given under such circumstances is not only useless, but also actively harmful, as it would appear that the absorption of fluid from the bowel is actively hindered by the presence of glucose, for we have observed that glucose salines are mildly irritant and are neither so quickly nor so readily absorbed as are normal rectal salines.

The obvious sequence to these investigations seems to be the administration of insulin to patients in the condition of post-operative shock. This has been carried out in a few cases, but the number of these is insufficient to draw a definite conclusion at present; it appears, however, to be of value, and further investigations are in progress.

I should like to take this opportunity to thank the surgical staff at St. Mary's Hospital for their kindness in allowing me to use their cases.

REFERENCE.

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PERI-ARTERIAL SYMPATHECTOMY WITH LIGATURE OF THE FEMORAL VEIN IN THE TREATMENT OF DIABETIC GANGRENE: A RECORD OF FIVE CASES.

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UNTIL quite recently the operation of high amputation has been the surgical treatment almost universally employed for diabetic gangrene. There is no doubt that this method when adopted has led to the greatest number of successes in the long-run, the patient subsequently remaining free from local recurrence of the disease for some considerable time. Low amputation, when attempted, has usually been followed by disaster.

There is no doubt that the proportion of recurrences after high amputation is at the present time much larger than it should be. The reason for this is not far to seek. It is largely due to prevarication with unnecessary delay before operative measures are adopted, when the time factor is one of extreme importance. The patient (and sometimes the surgeon) will temporize in the hope that an operation may prove unnecessary. The use of insulin as a pre-operative measure has done much to increase this delay; for the progress of the gangrene may be checked for a time, thus too often leading to a sense of false security. A moment's consideration of the underlying pathology of the disease—that it is a malnutrition phenomenon due essentially to changes in the blood-vessel walls of a permanent nature—must lead to the realization that the action of the insulin can only be a transient one, and cannot materially affect the course of the gangrene. Sooner or later the gangrene will recommence to spread in spite of insulin therapy. The amelioration of the local condition is of a temporary nature only, and does not warrant delay in amputation. One cannot overstress the importance of early amputation in these cases. Insulin, however, has its place in the operative treatment of diabetic gangrene. Used as a pre-operative measure, by rendering the patient sugar-free or by temporarily reducing his blood-sugar, it places him in a better position to withstand the anæsthetic and the operation itself.

Hunter's work on the enervation of blood-vessels has opened up a new field in the surgical treatment of these cases. Although still in its infancy, the operation of peri-arterial sympathectomy may yet prove to be the means of treating the condition in a more satisfactory and less radical manner.

Below are appended the notes of five cases of diabetic gangrene treated at the Royal West Sussex Hospital by conservative surgical measures during the last two years.

SYMPATHECTOMY IN DIABETIC GANGRENE 287

Case 1.—L. M., age 63, married, three children, was admitted to hospital on Dec. 12, 1926, with a twelve years' history of diabetes mellitus. She had had both eyes operated on for cataract some years previously, and also gave a history of numerous carbuncles.

ON ADMISSION.—The patient was found to be a well-covered and robust individual. On the right foot there was a patch of moist gangrene involving the first, second, and third toes, and extending well on to the ball of the great toe, with surrounding œdema of the foot, most marked on the dorsum and extending upwards as far as the ankle. The dorsalis pedis, tibial, plantar, and popliteal pulses were palpable in the left leg, but not in the right. Temperature, 100°; pulse, 100; respiration, 20; urine: sp. gr. 1010, sugar 1.95 per cent, albumin a trace.

TREATMENT.—On the day of admission, insulin 15 units three times a day was given, and the urine became sugar-free almost immediately, remaining so throughout the patient's stay in hospital. Subsequently the dose was reduced first to 10 units and later to 5 units per diem. A moderately strict diabetic diet was given. On admission the foot was placed uncovered in a radiant-heat bath. It smelt badly, and from time to time exuded a small amount of foul serosanguineous fluid. Two days after admission, as the gangrene and the œdema were extending, an operation was performed.

Under gas and oxygen an incision about 4 in. long was made in the thigh. The femoral vessels were exposed in Hunter's canal and a peri-arterial sympathectomy was performed. For a distance of 1 in. the adventitia was stripped off the artery, two minute muscular twigs being at the same time ligatured. No obvious pallor of the vessel was noticed after removing the adventitia. The arterial walls were thickened, hard, and calcareous. The femoral vein was then ligatured in two places, and the wound closed.

After the operation the leg was returned to the radiant-heat bath. On the next day (Dec. 15) a remarkable change was noticed in the limb. The dorsalis pedis, plantar, tibial, and popliteal pulses were now not only palpable, but of distinctly greater volume than those of the opposite limb. This increase in pulse volume persisted for about twelve days and then appeared to decrease. Two days after the operation a red erythematous line of demarcation was seen at the edge of the gangrenous part. The area of gangrene had not extended since the operation. On the third day it was noticed that the œdema of the foot was less marked, and two weeks later it had almost completely disappeared. The diseased part was much drier. Five weeks after the operation the gangrenous area was quite dry and mummified. Eight weeks later it was almost completely separated from the rest of the foot, being held to it by a small pedicle of sloughing connective tissue. The œdema had entirely disappeared. At the end of the thirteenth week the diseased portion had separated. The temperature was 98.6°, pulse 72, respiration 20. The urine was sugar-free with insulin 5 units daily. No pain was felt in the diseased limb. Up to the time of writing there has been no recurrence of the trouble.

Case 2.—S. H., age 59, a baker. He had been treated for some years for diabetes, latterly with insulin, on which he had remained sugar-free for nearly a year. An intelligent, hard-working man, he attributed his present condition to the fact that for some years he had had a painful corn on the ball of the second toe of the left foot. Three days before admission he noticed that the toe was discoloured and painful. This he thought at first to be due to careless chiropody, and while blaming himself he took little notice of it. Two days later the condition was much worse, and now, thoroughly alarmed, he presented himself at the hospital.

ON ADMISSION (Jan. 30, 1927).—Temperature, 100.6°; pulse, 100; respiration, 20. There was well-marked moist gangrene of the second, third, and fourth toes of the left foot, extending up on to the dorsum for a distance of about $\frac{1}{2}$ in. opposite the third toe, with an area of surrounding œdema extending nearly to the ankle-joint. The heart, chest, and abdomen were normal. Urine: sp. gr. 1105, reaction acid, sugar + +, albumin a trace.

TREATMENT.—The foot was at once placed in a radiant-heat bath, and insulin 20 units given daily. The subsequent clinical history of the case is very similar to that of the preceding one. On the day after admission an operation was performed on the left foot. The artery and vein were exposed in Hunter's canal, and a peri-arterial sympathectomy performed, with ligature of the femoral vein. Following the operation the dorsalis pedis, plantar, tibial, and popliteal pulses were all temporarily increased in volume on the side operated upon, and a line of demarcation rapidly formed at the edge of the gangrenous area. On the tenth day, at the man's own request, in order that he might return to his business as soon as possible, a Syme's amputation was performed. The wound healed by first intention, and the patient left hospital, with a very good clean and serviceable stump, fourteen days later. The patient on discharge was sugar-free with 10 units of insulin daily.

Case 3.—H. Y., age 65, a labourer. In December, 1926, whilst at work, the patient was struck on the right foot by a plank which became dislodged by a fall of gravel. The foot was bruised, but no open wound was present. The bruising remained until his admission into hospital on Feb. 21.

ON ADMISSION.—The patient was a robust individual, but his arteries were thickened and tortuous. There was moist gangrene of the whole of the second toe of the right foot, with surrounding œdema spreading on to the dorsum of the foot for a distance of 3 in. The right dorsalis pedis pulse was hardly palpable. The other pulses in the limb were palpable, but not to the same extent as those on the left side. The urine contained sugar ++. The following day the gangrene had extended to the third toe, and the œdema had spread as far as the ankle-joint.



FIG. 202.—Case 3. The limb after Syme's amputation. The scar from the femoral operation can be seen.

TREATMENT.—The limb was placed in a radiant-heat bath, and insulin given. As the disease was spreading after twenty-four hours, a left femoral peri-arterial sympathectomy with ligature of the femoral vein was performed *under gas* and oxygen anaesthesia. Three days after the operation the condition was as follows: The gangrenous area, which had extended a little during the first twenty-four hours after operation, was now stationary and not increasing in size. The right popliteal pulse was of greater volume than the left. The dorsalis pedis pulses were, as near as could be judged, of equal volume. The right foot was sweating profusely, and the patient was complaining of a feeling of heat and fullness in the leg, which had been present since the operation. On the same evening a Syme's amputation was performed without a tourniquet. There was very little bleeding (just a slight ooze at the site of amputation). The subsequent treatment consisted of radiant-heat baths and dry dressings. On April 23 the stump was completely healed. (Fig. 202.)

Case 4.—H. J., age 65, was admitted into hospital on April 26, 1927, with a six months' history of a running sore on the little toe following the excision of a corn.

ON ADMISSION.—The patient was found to be suffering from diabetes mellitus. His blood-sugar was 1.2 per cent; urine: sp. gr. 1.120, sugar ++, albumin +. The

whole of the left little toe was gangrenous. In addition, the left leg was infected with a gas-forming organism to a point 3 in. below the knee-joint. Crepitations could be elicited on palpation over the lower parts of the limb.

TREATMENT.—Insulin in large doses, 20 units three times a day, was given, and multiple incisions made into the limb, which was then irrigated by Carrel's method. Three days later a left femoral peri-arterial sympathectomy with ligature of the vein was performed under gas and oxygen anæsthesia. Five days later a Farabœuf's amputation was attempted, but deep pus was encountered at the site of operation. It was thought advisable, therefore, to perform a Stokes-Gritti's amputation at a higher level. This was done; but in spite of insulin therapy and radiant-heat baths there was a recurrence of the gangrene in the stump, and the patient died of diabetic coma on June 11, six weeks after admission.

This case is of interest in that it is an example of a clinical variety of the disease which is rather more rapid in its course than is usually the case. The rate at which the disease progresses is of necessity dependent upon two factors—the degree of primary involvement of the pancreas, and the powers of resistance of the tissues of the patient. There are some cases which terminate fatally with rapidly progressing gangrene of one or both lower limbs in the course of forty-eight to seventy-two hours. In such cases the spread of the gangrene is so rapid, even with insulin therapy, that operative measures cannot be undertaken; or, if amputation is attempted, a recurrence invariably and rapidly develops in the stump. Not every case of diabetic gangrene is suitable for surgical treatment.

Case 5.—R. M., age 40, gave the history that three months previously the left leg suddenly became pale and painful and shortly afterwards turned black. On April 20, 1927, he was admitted to hospital.

ON ADMISSION.—He was breathless and at times cyanosed. Examination of the chest showed that the right side of the heart was $\frac{1}{2}$ in. to the right of the lateral border of the sternum. The apex beat was in the sixth space just external



FIG. 203.—Case 5. Photograph of limb after removal, showing site of amputation immediately above gangrenous area.

to the nipple line. The auricle was fibrillating. A systolic murmur was heard at the apex conducted to the axilla. There was, in addition, dry embolic gangrene of the whole of the left leg and foot to a point 2 in. below the knee-joint, with a well-defined line of demarcation. The left femoral pulse was faintly palpable high up in the groin.

TREATMENT.—Two days after admission a left femoral peri-arterial sympathectomy was performed, with ligature of the femoral vein, under local anæsthesia. No pulsation of the artery was visible or palpable at the time of operation. Two days later the line of demarcation at the edge of the gangrene was more distinctly marked.

Two weeks later an amputation through the lower third of the thigh was performed under local anaesthesia, using a 2 per cent solution of apophysin and adrenalin. A tourniquet was not employed, as the femoral artery was not patent and was replaced by a solid cord. The wound healed by first intention. (Figs. 203, 204.)



FIG. 204.—Case 5. Stump after amputation with local infiltration. (Note femoral scar of sympathectomy.)

The interesting feature of this case is that, although when the limb was amputated the femoral artery was found to be replaced by a solid cord, yet there is no doubt that marked congestion was produced in the limb following the sympathectomy, resulting in a quickening up of the process of elimination of the dead tissue. The power of vasodilatation in the smaller vessels distal to the site of the block, which were functioning by means of the collateral circulation, was still, of course, controlled by the nerves running in the vessel wall, although that vessel had lost its blood-carrying function.

There is good reason to believe that the combined operation of ligation of the femoral vein with sympathectomy of the artery is an improvement on either of these measures used by itself. One has only to examine the hard 'gritty' calcareous walls of the blood-vessels in a case of diabetes of some years' duration to realize that, even when denuded of all vasoconstrictor fibres, the power of dilatation of the vessel distal to the site of operation must of necessity be impaired owing to the mechanical obstacle caused by the degeneration of muscular tissue. Vasodilatation does occur after this operation: of that there is not the least doubt; and a form of active congestion of the limb is thus produced. It is to this active congestion that the good effects of the treatment are attributed. Ligation of the vein produces a similar hyperaemia by passive congestion. When these two methods are combined a summation effect is produced.

CONCLUSIONS.

Some cases of diabetic gangrene are too rapid in their course for surgical measures to be attempted. In those cases which are suitable for operative treatment the following method has given good results:—

1. A short preliminary course of insulin therapy to render the patient more fit to stand the operation to follow.
2. Local treatment in the form of radiant-heat baths.
3. Early operation. The operation of choice was a combined method of peri-arterial sympathectomy of the femoral artery in Hunter's canal, with ligation of the femoral vein.
4. After an interval of from five to ten days, low amputation.

THE STRUCTURE AND ORIGIN OF THE 'MIXED' TUMOURS OF THE SALIVARY GLANDS.*

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For the purposes of this paper, all the tumours of the parotid and submaxillary glands which have been removed at St. Mary's Hospital during the years 1912-23 inclusive have been examined. Three cases have been discarded, in which the process of tumour formation was entirely obscured by chronic inflammatory changes of long standing; omitting these, the total number of cases available for examination is 25. Of these, 17 occurred in the parotid and 5 in the submaxillary, while the origin of the remaining 3 is not known.

The sex distribution shows 11 cases in males and 14 in females. Great variation is seen in the age of onset, the lowest recorded age being 10, omitting one case which is vaguely stated to have started 'in childhood', and the highest age 55. In a certain number of cases details of age were not obtainable.

A remarkably constant feature, which has been noted by many other observers, is the long period which elapses from the first appearance of the tumour until the patient first seeks advice. In only three of these cases is this period less than 5 years (they are 6 months, 2 years, and 3 years respectively), in several it is over 10 years, and in two cases it is as much as 26 and 27 years. In all these cases of long duration it is found that the tumour remained more or less stationary in size for many years, and then suddenly began to grow rapidly, usually without apparent cause, although in some cases the patient attributes it to some blow or injury.

It is not intended to attach any importance to statistics obtained from such a limited number of cases, but this summary is given to show that there is a general agreement between these and the statistics of others who have worked with more material.

STRUCTURE OF A TYPICAL 'MIXED' TUMOUR OF THE PAROTID.

By a typical mixed tumour is meant a tumour having the appearances which have been described under this name by other observers. Out of the 25 cases, 16, or 64 per cent, fall definitely in this class, presenting most of the characteristics which have been described as belonging to these tumours.

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One of these tumours presents for examination two main parts, the parenchyma and the stroma; the relative proportions of these vary very greatly in different tumours, and in different parts of the same tumour. For descriptive purposes, however, two main types of tissue only need first be considered:—

1. Those parts of the tumour where the cells are abundant, lying closely packed together, and the stroma is very scanty or almost non-existent (*Fig. 205, A*).

2. Those parts where there is much stroma, and the cellular elements are widely scattered, lying singly or in small groups (*Fig. 205, B*).

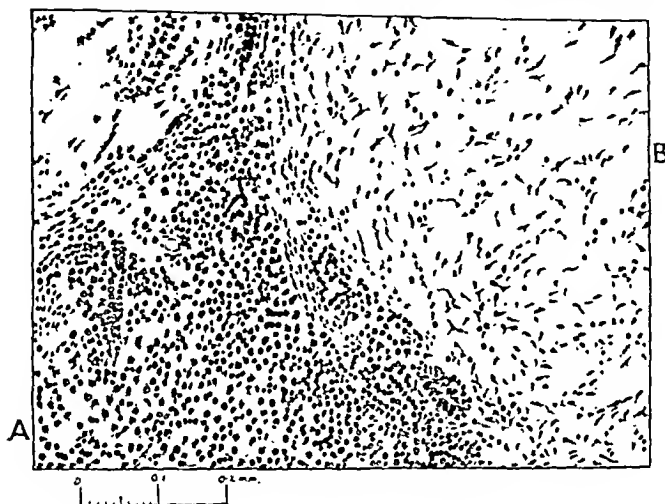


FIG. 205.—Section showing: A. Closely packed cells: B. Widely scattered cellular elements.

In these two types of tissue, the cells, in addition to the differences in their distribution, present great differences in their form and general appearance.

In *Fig. 205, A*, where there is much parenchyma and little stroma, the cells, being tightly packed together, show very indefinite outlines. In most places they merge into one another, giving the appearance of a syncytium, but occasionally their outlines can be distinguished, and they are then generally polyhedral, cubical, or low columnar. Their nuclei are almost invariably large, and round or oval, showing very distinct nuclear markings, and often a well-marked nucleolus. The cytoplasm shows no special characteristics.

In *Fig. 205, B*, on the other hand, where there is an abundant stroma, the cells undergo great changes in appearance. The nuclei generally lose their regular shape and clear markings, and become irregular in shape, variable in size, and stain uniformly deeply with hæmatoxylin. The cells themselves tend to become triangular or spindle-shaped, and the cytoplasm appears to extend out from the corners of these irregular cells in fine processes which blend imperceptibly with the stroma.

The stroma itself consists of two distinct parts. Firstly, there is a network of fine fibrillar connective tissue running between the cells and groups of cells. This provides support for the cells, and also carries the very limited number of vessels which supply the tumour. These vessels, few in number, are generally very thin-walled, often consisting of merely an endothelial lining. They are present in small quantities in the more cellular parts of the tumour, but are often practically absent from the less cellular parts. In these parts the connective-tissue stroma is practically non-existent too, and it is here that the second element of the stroma comes into prominence—a substance closely resembling mucin. Whether it is pure mucin is difficult

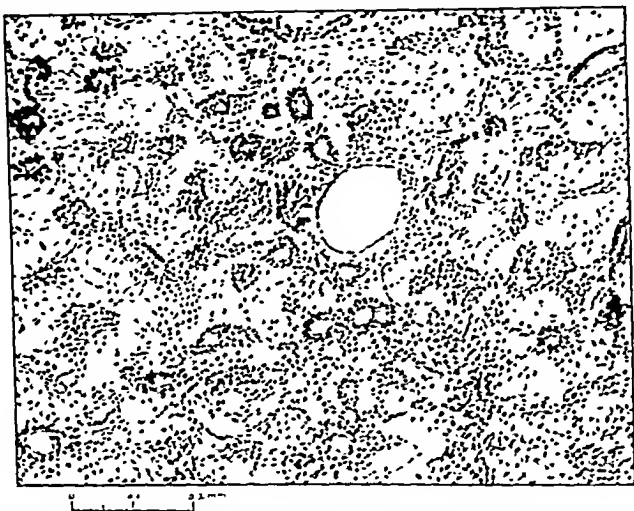


FIG. 206.—Section illustrating the alveolar arrangement of cells.

to say, but microscopically it is indistinguishable from mucin, and stains well, often intensely, with Mayer's mucicarmine. This substance varies in its appearance, in places having a definite fibrillar structure, when it stains most intensely with mucicarmine, and in other places being quite homogeneous in appearance, not unlike the matrix of cartilage. In these parts the staining reaction is not so well marked. There are intermediate stages between these extremes, and all forms may be present in the same tumour, clearly representing different stages in a biochemical change which is taking place.

As will be shown later, this mucinous material should not strictly be regarded as stroma, as in its origin and nature it is quite distinct from the stroma proper, but it is described as such purely for convenience in the account of these tumours.

Finally, in these less cellular parts, especially where the mucinous stroma is homogeneous, the cells occasionally have a special relationship to the stroma, lying apparently free inside small circular vacuoles in the stroma. Round the periphery of these vacuoles there is usually some condensation of the mucinous material, leading to a more deeply-stained ring in a mucicarmine

preparation, and the whole appearance is scarcely distinguishable from a section of cartilage stained by the same method. It may be noted here that the matrix of cartilage stains, though not very deeply, with mucicarmine.

So far, in the account of the more cellular parts of the tumour, only the shape and general appearance of the cells have been described, and no mention has been made of their arrangement. This varies greatly in different parts of the tumour, but the variations may be grouped under four main headings:—

1. Irregular masses of cells, of varying size, in which the cells are closely applied to each other, without any definite arrangement. These portions of the tumour are comparable to the cytomata of Powell White's classification.



FIG. 207.

2. Adenomatous arrangement. In these parts the cells show a definite tendency to imitate glandular formation, and occasionally nearly perfect reproductions of salivary-gland ducts may be found.

3. Alveolar formation. In such places alveoli of varying sizes are found (*Fig. 206*). Many of these may be formed by the dilatation of the duct-like structures mentioned in the previous paragraph. Another possible method of formation will be mentioned later, when the derivation of the various parts of the tumour is

discussed. These alveoli are sometimes empty, and sometimes contain a homogeneous material which stains very intensely with eosin or picric acid. At other times they contain mucin.

4. Rarely a type of tissue is met with which at first sight appears to consist of interlacing double columns of cells which have split down the middle of the columns. On examination of many sections, however, it is found that this appearance is produced by papilliferous ingrowths into dilated alveoli, or by irregular compression of alveoli (*Fig. 207*).

THE ORIGIN OF THE DIFFERENT ELEMENTS OF THE TUMOUR.

In the last forty years there have been many attempts to explain the origin of the mixed tumours of the salivary glands. The main theories which have held the field at different times are as follows:—

1. *The Endothelial Theory.*—This theory, by which the tumours were explained as being derived from endothelium of lymph-vessels, was at one time very widely held, but is now being gradually discarded. It was founded almost entirely on observation of the shape and microscopic appearance of the cells, and these may be explained more easily and plausibly by other theories. It will be shown later, in the detailed discussion of the origin of

the various parts of the tumour, that these tumours do not conform in many respects to the characteristics by which endotheliomata may be recognized. Kettle,¹ in a list of points of importance in diagnosis of endotheliomata, mentions "the absence of any suggestion of a glandular or acinous formation", and it has already been mentioned that the parotid tumours do in many places show a very definite glandular formation.

2. *The Embryonic Theory.*—A staunch upholder of the embryonic theory is E. Forgue,² who places these tumours in a subdivision of the big group of 'dysembryomes', or tumours derived from pluripotential cells which have ceased to develop further at different stages of the development of the embryo, and which have later given rise to neoplasms.

3. *The Branchial Theory.*—The main reason for the launching of this theory was to explain the presence of cartilage in the tumours. It is proposed to show in this paper that the tissue which has gone by the name of cartilage is formed from epithelial tissues, and if this can be demonstrated it becomes unnecessary to consider this theory further.

4. *Origin from Embryonic Gland Germs.*—This theory that the tumours are derived from embryonic rests of gland tissue has been put forward by a limited number of writers, but has never received a very general acceptance. In order to explain the occurrence of epithelium and connective tissue it is necessary to assume that the rests consist of both ectodermal and mesodermal elements, or else that the connective tissue is derived by metaplasia from the epithelium, in which latter case the next theory will account equally well for the appearances observed.

5. *Origin from Fully-formed Gland Tissue.*—By this theory, which is gradually becoming adopted by more and more writers, the tumours are supposed to be derived from adult gland cells. A. Fraser³ discusses the question, and after comparing the tumours with the effects of ligation of the parotid duct in dogs he comes to the conclusion that the tumours are derived entirely from the cells of the ducts, and that the cartilage is formed by metaplasia from the epithelial elements. R. Kennon⁴ also regards them as adenomata, but he gives no account of the formation of the cartilage, which appears to be the point which has given rise to most of the discussion with regard to the origin of these tumours.

In a discussion of the parotid tumour, then, there are two main points which require to be elucidated. They are: (1) *The origin of the cellular part of the tumour*; (2) *The method of formation of the 'cartilage'*.

1. *Origin of the Cellular Part of the Tumour.*—When considering the cells of the tumour, it is clearly necessary carefully to examine their arrangement in different parts of the tumours. Another possible source of light would be the discovery of any definite connection between the tumour and the normal gland, with transitional forms of cells. Thirdly, any evidence of attempts at secretion on the part of the cells may throw some light on the problem.

In attempting to draw any conclusions from the arrangement of cells in a tumour presenting such diversity of arrangement as does the parotid tumour, our chief hope lies in finding cells which by their disposition give some indication of their origin, and tracing as far as possible the development

of other less differentiated cells from these. In a search through many sections of the sixteen tumours now under consideration, one type of formation has been met with which has a close resemblance to normal tissue—the adenomatous formation. This occurs in varying degrees in different tumours; in many it is so obscured by secondary changes as to be almost unrecognizable, but in others it is sufficiently distinct to leave little doubt as to the origin of the cells. One tumour in particular shows this well. It is in all respects a typical 'mixed parotid tumour'; that is to say, it shows all the characteristics which have been ascribed to these tumours, but at the same time the cells show such a marked tendency to form more or less perfect representations of ducts that the arrangement can hardly be regarded as fortuitous. Several of these duct-like formations are shown in *Fig. 208*.

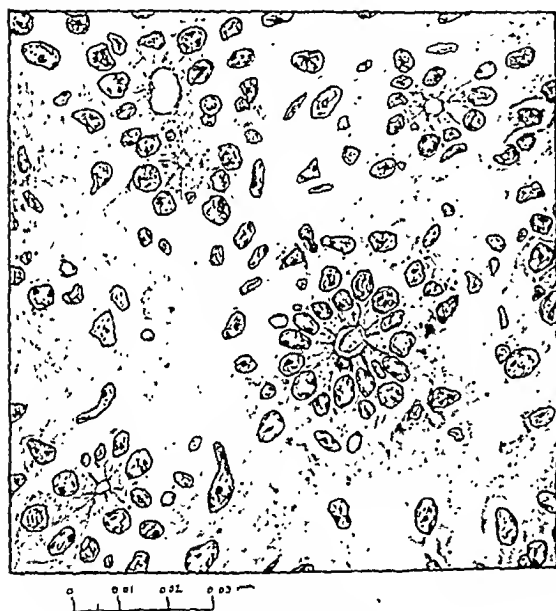


FIG. 208.—Typical 'mixed parotid tumour', showing duct-like formations.

A number of wedge-shaped columnar cells are arranged so as to enclose a small oval or circular space; the cells are well marked off from each other, their nuclei are rounded or oval, lying towards the base of the cells, and showing distinct nuclear markings, and their cytoplasm shows the longitudinal striation so characteristic of the cells of the salivary ducts. The margin of the lumen is very clear-cut and definite, and from this margin can be seen radiating lines, marking the divisions between individual cells. As has already been mentioned, the lumen of one of these structures may present three different appearances:—

a. It may be empty. This may be real, or merely apparent, due to the solution or falling out of the contents.

b. It may contain a homogeneous material, which stains deeply with eosin or picric acid, and strongly resembles the colloid found in the thyroid. This material is referred to by Forgue in a consideration of these 'tubes pseudo-glandulaires'; he considered it due to necrosis of cells formerly occupying the centre of the spaces. It is difficult, however, to accept this explanation, on account of the perfect regularity in the shape of the lumen, with the clear-cut inner borders of the columnar cells bounding it. Such perfect representations of ducts could scarcely be formed in large numbers by mere chance necrosis of the inner members of a mass of cells.

c. It may contain mucin. No stress is laid on this fact by other writers,

but it appears to be intimately connected with the formation of some of the characteristic tissues of these tumours.

There is another point to be noted with regard to these structures, which may be seen to some extent in *Fig. 208*, but is better observed in some of the other tumours—the presence of a double layer of cells enclosing a lumen. In *Fig. 208*, outside the layer of columnar cells, can be seen an irregular layer of nuclei of varying size and shape. The outlines of the cells to which these belong are indistinguishable, but they are strongly suggestive of a ring of irregular cells surrounding the layer of columnar cells. This appearance is met with in a greater or less degree in almost all the tumours. In some the outer layer of cells is very definite; there is an inner layer, sometimes



FIG. 209.—Showing the double layer of cells enclosing a lumen.

columnar, sometimes more flattened; outside this there is a layer of irregular, badly-defined cells, with small deeply-staining nuclei. *Fig. 209* shows this appearance from another tumour of the series. Fraser has drawn attention to this appearance, and notes its resemblance to the two layers of cells seen in normal salivary ducts. He states that the outer layer of cells may proliferate outwards, thus giving rise to irregular solid masses of cells. This proliferation is well seen in a large number of tumours in this series now under consideration, and it seems probable that the primary structure is in all these cases a duct-like formation, which by proliferation of its outer layer of cells gives rise to large or small irregular masses of cells. The further the cells are removed from the primary duct formation, the more variable

is their appearance; their shape becomes irregular, their cytoplasm loses all definite structure, and their nuclei often lose their definite shape and stain uniformly deeply with hæmatoxylin.

For some time it appeared that the duct was the only source of the tumour-cells, for want of evidence of any other origin. In one tumour, however, a point was found where the tumour and gland came into contact, and the transition from one to the other might be studied. This did not appear to be a case of infiltration of the gland substance by the tumour; there was nothing to indicate malignancy in the structure of the growth, which was encapsuled except at this one place, showed no mitotic figures, and was apparently a slow-growing benign tumour of the rather acellular type. On staining sections rather deeply with hæmatoxylin, the zymogen granules in the secreting cells of the gland stood out prominently as deep bluish-black



FIG. 210.—Zymogen granules standing out in the cytoplasm.

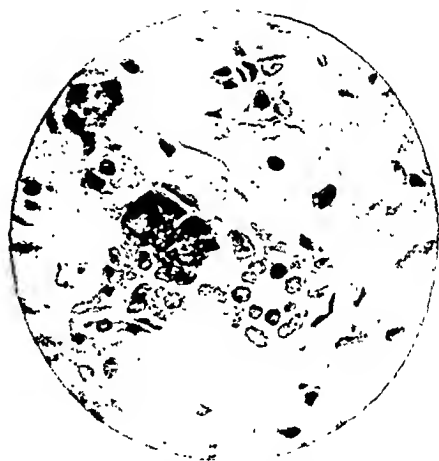


FIG. 211.—Tumour-cells producing mucin, and forming zymogen granules within their cytoplasm.

dots in the cytoplasm (Fig. 210). These granules, which are never present in the ducts, were numerous in the normal gland and were absent from the tumour-cells, but round about the point of contact between the tumour and the normal gland many intermediate forms were observed which had definitely lost their normal shape and arrangement. They lay in groups embedded in a matrix of mucinous material so characteristic of these tumours, but yet contained these zymogen granules in varying amounts. Thus we see cells which have taken on what is, as will be shown later, one of the chief properties of the cells of these tumours—the power of producing mucin—and yet retain to some extent their original function of forming zymogen granules within their cytoplasm (Fig. 211). Furthermore, the groups of cells referred to in many cases consist partly of cells containing granules, and partly of cells without granules, which cannot be distinguished from the tumour-cells further from the normal gland; these cells are in intimate contact in the same group, and are often arranged so as to enclose lumina filled with mucin, and a careful study of many sections of this part of the tumour

leaves one with a strong feeling that this is a case of the tumour-cells being derived from the secreting cells of the gland. This seems to be the only explanation of the fact that the cells in question are performing normal and pathological functions at the same time.

2. Method of Formation of the 'Cartilage'.—The next point to be considered is the nature of the myxomatous changes in these tumours, and the mode of formation of the so-called cartilage. It is proposed to consider these together, as they appear to be intimately connected with each other.

Several sections from each tumour were stained with Mayer's mucicarmine, and a substance which stained deeply with this was found abundantly in most of them. This substance is most prominent in the less cellular parts of the tumours, where it forms the intercellular substance filling up the spaces between the scattered cells or groups of cells. It has already been described in the account of the structure of a typical parotid tumour, but mention may be made here of the fact that it varies greatly in the intensity of its staining reaction with mucicarmine. In most cases it stains well, when it frequently has a fibrillar structure; in some cases the staining is not so intense, and here it often presents a more homogeneous appearance, showing no definite microscopic structure. This substance appears to be the product of some change in the cells of the tumour, and the problem before us is to endeavour to find out something about its origin and mode of production.

The first tumour which appeared to throw light on the problem was one containing large amounts of mucin, all of which stained very intensely with mucicarmine. Most of this mucin is found enclosed in rings of cells, representing either cyst-like spaces or small tubules. But on careful examination with high powers it was found that many of the cells showed a vacuolated appearance of their cytoplasm, and in these vacuoles, which varied in size from minute points to spaces considerably larger than the nuclei of the cells, there was generally a globule of mucin. This globule did not entirely fill the space, but around the margin of the vacuole, apparently adhering to the cytoplasm of the cell, there was a ring of mucin. This appearance, shown in *Fig. 212, A, B, C*, was observed in many places in three of the tumours, and less frequently in several more. The whole appearance is very striking, and strongly suggestive of a secretion of mucin into intracellular vacuoles. As the amount of mucin increases, the walls between neighbouring vacuoles become thinner, and they coalesce, forming larger spaces; in this way may be formed many of the large spaces containing mucin which are seen so frequently.

There is another appearance very similar to the foregoing which is met with occasionally—the presence of a number of small granules of mucin in the cytoplasm of the cell. It is possible that this may be an earlier stage of the vacuole formation, the mucin appearing first as fine granules, which later coalesce to form one large intracellular globule of mucin.

This formation of large cyst-like spaces bounded by one or more layers of cells and containing mucin must not be confused with the presence of mucin in the lumina of the duct-like structures previously mentioned. These structures so closely resemble ducts that it appears very unlikely that they are formed in the manner just described. In the instances where their lumina

contain mucin, this may either have been secreted by the layer of columnar cells, or else poured into the lumen from other spaces with which they are in communication. It has not been possible to demonstrate the existence of such communication, and from the fact that there is generally a layer of mucin applied to the wall of the duct, it seems probable that it is a true secretion on the part of the cells.

A fourth method of formation of mucin has been observed in some tumours—an extracellular formation of mucin. In some of the more cellular parts of the tumours, if the solid masses of cells are examined, it is found that the cells have the appearance of being slightly separated from each other,

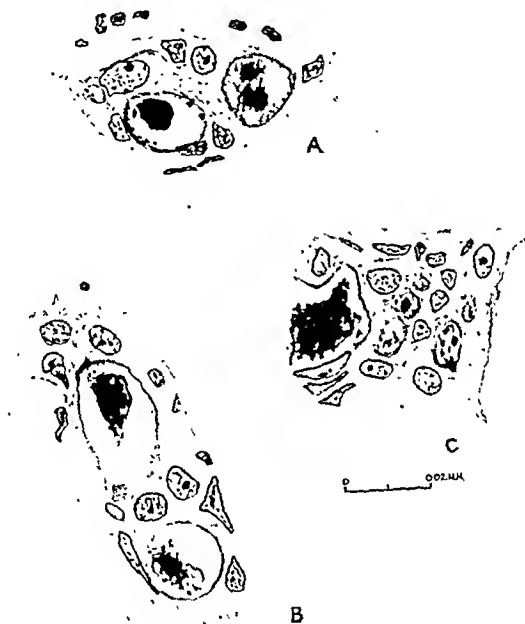


FIG. 212.—Adjacent portions of one section showing (A, C) intracellular vacuoles of varying size containing mucin, and (B) commencing breaking-down of the wall of a large vacuole.

and the space between adjacent cells is filled with fine fibrils of mucin. The appearance is very similar to that of the 'prickle cells' of squamous epithelium, except that the fibrils are not so regularly arranged as in the case of the prickle cells, and they stain deeply with *mucicarmine*.

A difficulty arises in attempting to determine whether this mucin formation, so characteristic of the salivary-gland tumours, is purely a pathological process, or whether it has any counterpart in the activities of the normal gland. In the submaxillary, many of the acini are composed of mucous cells, but in the parotid, from which the majority of the tumours are derived, no mucous cells are present in the human subject, according to all histologists. It so happened, however, that concurrently with the examination of these

tumours, a number of normal parotid glands, obtained from the post-mortem room, were also examined, in the hope, which was unfulfilled, of finding an early tumour which had not reached a sufficient size to have been diagnosed clinically. It was found that, though no mucous cells were to be discovered



FIG. 213.—Section showing mucin in both fibrillar and homogeneous forms.

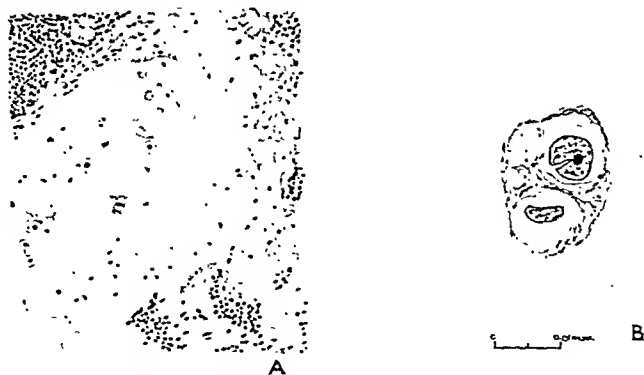


FIG. 214.—To show (A) Fully formed patch resembling cartilage (low power); (B) High-power view of two cells from A, showing the fibrillar mucin causing the appearance of a 'capsule'.

in the secreting cells of the gland, it occasionally happened that a few cells forming the walls of the ducts contained a small intracellular globule of mucin. Such cells are not very numerous, but they are sufficiently so to indicate that the formation of mucin may be one of the normal functions of the cells of the ducts of the parotid. If this is admitted, the formation of mucin by the

tumour-cells may be looked on merely as an exaggeration of a normal process instead of the taking on of a new function by the cell.

The mucin in the tumours, then, is formed in these four ways; as the amount produced increases, changes take place, the nature of which depends on whether the secretion is intra- or extra-cellular. When extracellular, the cells become more widely separated as more mucin is produced; when, however, the secretion is intracellular, the vacuoles become larger, more and more coalesce, and ever-increasing spaces filled with mucin are formed. In the breaking down of the walls between vacuoles, one or more cells often become separated from the main mass of cells and come to lie loose in the mucin, until, finally, large areas of mucin are formed, containing numbers of isolated cells or small groups of cells scattered throughout them.

As a patch of mucin increases still more in size, a further change often takes place. Towards the centre of the patch it loses its fibrillar structure and gradually becomes more homogeneous in appearance; at the same time it stains more faintly with mucicarmine. It tends to shrink away from the isolated cells scattered through it, leaving them lying in small vacuoles; round the periphery of these vacuoles the mucinous material is often more condensed, and takes the stain more deeply. It is this appearance which has been described as cartilage, and at first sight the resemblance is so close in some cases that one is almost irresistibly drawn to the conclusion that it is cartilage. It is only by following out the way in which it is produced that a correct idea of its nature can be formed. We have seen the formation of large areas of mucin, produced as a secretion by the tumour-cells; the transition from this to the homogeneous material, the matrix of the so-called cartilage, is not sudden, but gradual, and it is clear from the sections examined that this matrix is derived from the mucin, probably by some change in its chemical composition. Figs. 212-214 are drawings from neighbouring parts of the same section, and they show most of the stages in the formation and subsequent development of the mucin. It has been mentioned that the final product of this development cannot be distinguished in many cases from the matrix of cartilage, either by its microscopic appearance or its staining reactions. But the difference lies in the fact that it undoubtedly begins life as mucin, and only comes to resemble cartilage at a later period, after it is present in large quantities, and as a result of some chemical change. What the nature of this change is, it is difficult to say; but from the fact that the cartilage-like material is almost always found near the centre of the mucinous areas, and that vessels are not found in these areas, it seems probable that it is due to deficient nutrition.

The presence of the ring of deeply-staining mucin round the isolated cells, giving rise to the appearance of a capsule, would seem to be due to the fact that each cell continues to secrete mucin around itself, and this ring represents the part that has not yet undergone the change into the less stainable form. This appearance is shown in Fig. 214, where B is a high-power view of the small pair of cells seen in the low-power view, A. The gradual transition from the deeply-stained to the less-stained part should be noticed; nowhere is there a sudden change from the one to the other.

One further point with regard to the staining reaction of this mucinous

material should be mentioned. Fraser, in the paper previously referred to, states that he used cresyl-violet as a differential stain for the matrix of cartilage, and found that the intercellular substance in the salivary-gland tumours stained with this similarly to the matrix of cartilage. If, however, a section known to contain mucin and no cartilage, such as one of a normal submaxillary gland, be stained with cresyl-violet, it is found that once again the staining properties of mucin closely resemble those of cartilage. This stain is therefore of no assistance in determining the cartilaginous nature of this substance.

As a result of these observations, it would appear that in the tumours of this series cartilage does not exist. There is in many places a tissue closely resembling cartilage, but the cells in it are epithelial cells, derived from the other epithelial cells of the tumour, and the matrix is a degenerative product of the mucin which is formed by an exaggeration of a normal function of the epithelial cells.

THE ATYPICAL TUMOURS.

It now remains to discuss the nine tumours which have not been included in the group of 'typical mixed tumours', and to endeavour to bring them as far as possible into line with the others. In all these cases except one, the reason for omitting them from the list of typical tumours was the absence of any of the large areas of mucin containing scattered cells, which by secondary changes give rise to the so-called cartilage. It is proposed to divide these nine tumours into three groups for convenience of description.

Group 1.—This includes three tumours. Two of these present a great similarity in their microscopic appearance. Both consist mainly of masses of cubical or columnar cells, arranged so as to form large numbers of small tubules. The columnar cells are in some cases very high, and in many places more or less perfect representations of ducts are met with. The whole structure is very like the more cellular parts of many of the 'typical tumours', and it is impossible to exclude them from the group of adenomata. In one of these two there is considerable mucin formation; most of the tubules are filled with it, and everywhere the formation of intracellular vacuoles containing mucin is observed. In the other there is no formation of mucin by the cells, except at two places in the sections examined; at these two places moderate-sized areas of mucin are seen, containing scattered cells as seen in all the typical tumours, and at one of these places the so-called cartilage is observed. This serves further to establish the connection between these two tumours and the main group of typical tumours.

The third of this group presents a slightly different appearance, in that the cells are more closely packed together. The tubular arrangement, however, is still very evident, and leaves little doubt of this tumour being an adenoma, similar in all essentials to the preceding two. The resemblance is heightened by the presence of mucin, both intra- and extra-cellular, at one place in the sections examined.

Group 2.—Four tumours are included in this group, on account of one feature which is common to them all—the presence of a large number of mitotic figures. Mitoses are extremely rare in all the other tumours, but

in these four they occur in such numbers as to suggest that they possess some degree of malignancy.

The first of this group is a tumour with a dense fibrous stroma, and consisting of solid and tubular masses of polygonal cells with sharply-defined nuclei as shown in *Fig. 215*. Mitoses are very numerous, and in one or two places in the sections examined, infiltration of the gland substance by the tumour can be seen. No mucin is apparent anywhere, and the growth would appear to be an adenocarcinoma.

The next is a tumour very much more like the ordinary adenoma in many respects. It shows a great deal of mucin formation, both intra- and



FIG. 215.

extra-cellular. It differs from the adenomata, however, in having a dense fibrous stroma, like the preceding case, and in showing fairly numerous mitoses. These last are not nearly so frequent as in the last tumour, and the growth probably does not possess more than a low grade of malignancy.

The third growth is one which still more nearly approaches the simple adenoma. The cells show the typical tubular arrangement, and there is only a very scanty fibrous stroma. Mitotic figures occur, though not very frequently, and there is no mucin to be seen.

The last of this group closely resembles the first in many ways. It consists chiefly of tubular structures, composed of cubical cells; there is an abundant fibrous stroma, and mitoses are numerous. In addition, infiltration of the gland by the growth may be observed in more than one place.

This tumour, however, shows a copious formation of mucin, which fills all the tubules, and intracellular globules of mucin are also seen everywhere.

Group 3.—This includes two tumours which are put together because they do not fall naturally into the other groups. One is a quite small localized tumour, not more than 15 mm. in diameter, and entirely encapsuled. In a large part it consists of a solid mass of cells of irregular shape, with no definite arrangement, but in other parts the cells take on a columnar shape and are arranged in the characteristic tubules of the adenoma. There is no mucin, and a prominent feature of the tumour is its extreme vascularity. Everywhere there are thin-walled capillaries, many of them extremely dilated and filled with blood, others empty and collapsed. The other requires no detailed description. It is a typical papilliferous cystadenoma, consisting of dilated cyst-like spaces almost entirely filled by papilliferous ingrowths. No mucin is to be seen.

These nine tumours, then, which were classed apart from the 'typical' tumours, show one point in common with the others—their undoubted epithelial origin. They differ from the typical tumours and from each other in two ways—by their degree of malignancy, and by the extent of the secondary changes. The three simple adenomata all show some mucin formation, which is much greater in one of them than in the other two. Only one shows the further changes which lead to the pseudo-cartilage formation. The first of the growths in Group 3 can also be classed as one of these, and this shows no secondary changes whatever.

In the second group we have four tumours, showing similar structure, and all giving some indication of malignancy, greater in some than in others. Two of these show a considerable amount of mucin, and two show none, but this variation is not in proportion to the rapidity of growth as indicated by the number of mitotic figures present. The least malignant of these is probably only in a small degree removed from the simple adenomata, and there appears to be a gradual transition from the entirely innocent tumours to the definitely malignant. Even the most malignant, however, may still show enough of the secondary changes to demonstrate its connection with those tumours at the other end of the scale of malignancy, and it seems probable that all the twenty-five tumours which have been examined, with the exception of the papilliferous cystadenoma already mentioned, have the same essential structure, the difference between them being a difference in degree of malignancy and in the amount of secondary changes.

CONCLUSIONS.

1. The so-called mixed tumours of the salivary glands are not in reality mixed, but are entirely epithelial in origin. They are in most cases derived from the ducts of the gland, but occasionally arise from the secreting cells.

2. The mucinous material which is such a prominent feature of most of these tumours is a true secretion of mucin by the tumour-cells, and this is only an exaggeration of a normal function of the gland-cells.

3. The tumours do not contain cartilage. In the substance which has been described as cartilage, the matrix is formed by a change in the mucin

of the tumour, whereby it loses its fibrillar appearance and its power of staining deeply with mucicarmine; the cells are epithelial cells.

4. Some of the tumours show varying degrees of malignancy; there is no definite dividing line between the innocent and malignant, and some of the more malignant may show many of the features typical of the innocent type of tumour.

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URETHRAL AND PERI-URETHRAL CALCULI.

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It is proposed in this article to deal with stones in the urethra and urethral pouches, but not to include the ordinary prostatic calculi. Urethral calculi are by no means of rare occurrence, but have been neglected in the literature, and especially so in the English-speaking countries, articles being largely composed of records of cases. Bourdillat¹ in 1869 published an extremely interesting thesis dealing fully with the subject, and Englisch² in 1903 wrote a long article and analysed 405 cases. In this country Morton³ in 1906, and Monsarrat⁴ in 1912, dealt particularly with stones in the prostatic urethra.

Classification.—The following is the classification adopted :—

A. Urethral.—

- | | | |
|---|---------|-----------|
| 1. Formed in the urethra | .. .. . | Primary |
| 2. Formed elsewhere but impacted in the urethra | .. .. . | Secondary |
| 3. Formed elsewhere but having increased in size in the urethra | | |

B. Combined.—

1. Urethro-vesical
2. Urethro-preputial

C. Peri-urethral.—

1. Urethral stone which has formed a secondary pouch
2. Stone formed in a previously existing pouch
3. Peri-urethral stone in a cavity which subsequently acquires a communication with the urethra.

Monsarrat⁴ considered that the last-named variety might occur in the case of prostatic calculi. Some authors confine the term 'urethral calculus' to a stone actually formed in the urethra—that is, a primary urethral calculus in the foregoing classification—but the definition here adopted is the wider one given by Monsarrat⁴: "The term should be used for all calculi which are lodged in the urethra, whether formed in the urethra itself or elsewhere".

Causation and Composition.—Primary urethral stones have their origin in the same way as other urinary calculi, the important predisposing factors being: (1) Abnormal constituents in the urine; these may be due to abnormal metabolic processes or to chemical changes in the urine secondary to infection. (2) Conditions predisposing to urinary stagnation such as urethral strictures, pouches, or foreign bodies. Morton⁵ recorded an interesting example of the latter :—

A patient, age 48, had twenty-six years previously used a home-made wooden sound for the relief of retention of urine, and during the process the end had broken off. The stone, which was subsequently removed from a pouched urethra, was found to contain the piece of wood as its nucleus.

The following extraordinary case is recorded by Liston⁶ :—

The patient, forty-seven years previous to his application to me, and then about the age of 9 or 10, had incontinence of urine to a certain degree, and was frequently chastised by his parents on account of this occurrence during the night. In order to save himself from a flogging, he one evening, before going to bed, passed a brass curtain ring over the penis as far as he could. This expedient had the desired effect; but in the morning, swelling had come on to so frightful a degree as to prevent his removing it. . . . The skin under the ring gradually ulcerated; and as the ring sunk into the substance of the penis the swelling subsided. The integuments met and adhered over the foreign body, and there it remained. . . . On examination a broad hard substance could be felt surrounding the penis close to the symphysis. At the patient's urgent desire, an incision was made upon the lower part of the penis. Immediately on the knife touching the foreign body, the state of the case became evident. The incision was enlarged with a sharp-pointed bistoury, and the calculus . . . extracted. . . . A section has been made of the calculus, and two-thirds of the ring was found in its centre.

Primary stones are usually composed of phosphates, but rarely they may consist of other urinary salts. Secondary stones are of the composition of ordinary urinary calculi, but the deposits accumulated in the urethra are phosphatic in nature.

Situation.—As has been mentioned, these stones are either urethral or peri-urethral in situation. In the case of the former the site of formation or impaction depends upon anatomical or pathological conditions. If the urethra is normal, the stones will almost certainly be of the secondary variety and will be held up at the anatomically narrow parts of the urethra. Common sites are the prostatic portion, the stone being held by the narrow membranous urethra, and the fossa navicularis just behind the narrowest part of the passage. If the urethra is diseased, the stone will be situated in the pathological portion, and, as strictures are common in the region of the bulb, stones are often found there.

Peri-urethral stones are situated in pouches which may be merely depressions of the urethral floor, or in definite pouches having small communications with the urethra. These are found most commonly in the bulb and in the prostatic region in the male, and in the urethro-vaginal septum in the female. As will be seen from the classification already given, the relation of the stone to the pouch is variable.

Case 1.—Male, age 57. Four years previously he had had an external urethrotomy performed. For three years after this there had been no trouble, and then dysuria recurred. Five days before admission the scar had become swollen following cycling. On examination there was a mid-line perineal swelling extending to within one inch of the peno-scrotal junction, with a small hole in the centre which was discharging pus. An incision revealed six faceted stones which were lying in a mucous-membrane-lined cavity situated behind a stricture. Five of these stones are shown in *Fig. 216*. The stones were removed, and later an internal urethrotomy was performed. *Figs. 217 and 218* illustrate the condition. The stone examined was composed of triple magnesium ammonium phosphate.

Characters.—These calculi may be single or multiple. The single stones are usually ovoid or heart-shaped, and may show irregularities on the surface corresponding to the formation of the urethral wall. Israel⁷ reported a case in which the calculi had been formed in the prostatic urethra and

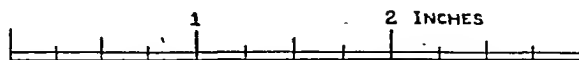


FIG. 216.—*Case 1.* Five stones removed from a urethral pouch.



FIG. 217.
the elevation
urethral pouch
noted at the point
an old external
scar, B.

FIG. 218.—*Case 1.* The pouch outlined with lipiodol.



showed a groove corresponding to the elevation of the verumontanum. These stones may at times become guttered by the passage of urine over the surface, and this may progress to a stage of canalization. The urethro-vesical calculi are often of a mushroom shape, the stalk corresponding to the urethra and the bulky upper portion lying in the bladder.

Multiple stones are present in one-third of the cases, according to Finsterer,⁸ and such are often barrel-shaped or irregularly faceted. There may be two or more up to a complete chain extending along almost the whole urethra. Monsarrat,⁴ in the article already referred to, describes a case of a prostatic diverticulum containing 86 stones; but they may be even more numerous than this, as cases have been recorded in which some hundreds of stones were present. The size is very variable. Bourdillat¹ in his thesis refers to a case of a giant stone, weighing 1450 gm., situated between the prostate and the rectum, the latter being perforated, with the formation of a urinary fistula. The peri-urethral calculi tend to attain a larger size than those within the urethra.

On section a secondary stone often shows the original nucleus, or, if it is formed by the fusion of a number of small ones, more than one nucleus is present. The situation of the nucleus is usually, but not invariably, in the distal end, the secondary deposits having accumulated particularly on the bladder aspect. If the stone has been lying in the cul-de-sac of the bulb or in a wide-mouthed pouch of the floor, secondary deposits may be found on the upper surface with the nucleus in the lower portion. Rarely the mucous membrane becomes lined with a gritty mortar-like material.

Sex Incidence.—As would be expected from a consideration of the anatomical features of the male and female urethræ, and of the rarity of pathological conditions in the latter, calculi are much more common in the male than in the female. Very large stones may be passed spontaneously in women, and Bourdillat¹ refers to the passage of a stone weighing 12 oz., which was followed by urinary incontinence. I consider the following case which has recently been under my care to be of some interest:—

Case 2.—Female, age 27. She stated that for eight years, following an attack of pleurisy, she had suffered from half-hourly frequency of micturition, accompanied by vulval pain. The urine was always thick and sometimes contained blood. On the day before admission retention occurred. The bladder was 3 in. above the pubis, and a calculus slightly larger than a date-stone was palpable in the urethra. Urethroscopic examination confirmed the diagnosis. Whip guides failed to pass, so the stone was crushed with forceps and removed in fragments. An unusual feature of the case was the narrow urethra, which permitted of the passage of the examination urethroscope only with difficulty. The interior of the bladder showed a bald papillomatous type of tumour with a phosphatic covering in the region of the right ureter. There were no other urinary calculi.

Age Incidence.—Urethral calculi are found at all periods of life, and may cause symptoms within a few days of birth. English² showed the following figures from 324 cases in which the age was known: 0 to 5 years, 54; 6 to 10 years, 38; 11 to 15 years, 35. In the ensuing periods of five years the figures vary between 15 and 27 up to the age of 50, after which they become less. According to Finsterer,⁸ primary calculi occur most commonly between the

ages of 40 and 50 years. Secondary ones are particularly common in childhood. In 1922 Thomas and Tanner⁹ collected 203 cases of urinary calculi in children, and found that in 12 per cent the calculi had become lodged in the urethra.

Clinical Features.—It must be pointed out that there is a marked difference in the clinical features between the primary and secondary stones. The former usually manifest themselves insidiously, and may be latent for many years without giving rise to any apparent trouble. By contrast, the secondary stones give rise to symptoms which are both dramatic in onset and severe in degree, and the fact that a migrating calculus may settle and grow in the urethra has been disputed, for the pain is such that it usually demands prompt removal of the stone.

In Children.—These calculi are almost always of the secondary variety, for in childhood pathological conditions of the urethra are rare, but a deposit of salts has been recorded after an operation for hypospadias. The onset is sudden, the child screaming, straining, gripping at the penis, and passing urine in small drops with marked frequency. These symptoms may be followed by retention, abscess formation, or urinary extravasation. Holmes¹⁰ says: "When summoned to a case of retention, we may almost assume that a calculus will be found impacted in some part of the canal".

In Adults.—Primary stones give rise to symptoms of varying degrees of severity, such as perineal and penile pain, urgency and frequency of micturition, hæmaturia, and urethral discharge. Dysuria may occur, possibly associated with alterations in the urinary stream, and may progress to complete retention, or the patient may find that by some manipulation or alteration in position the stream becomes free. If the stone is of large size, the patient's attention may be attracted by the presence of a lump. Secondary stones cause severe symptoms. The onset is sudden, pain striking along the penis, often with strangury, which may be followed by a sensation of obstruction or retention of urine. Occasionally there may be a feeling as of something left behind. Stones involving the prostatic urethra may result in incontinence of urine from interference with the sphincteric apparatus, or may cause pain on defecation.

In some cases the symptoms are intermittent. Annandale¹¹ described an interesting example in a male of 26 years. The calculi were lodged in a 'cyst' in the prostate and occasionally passed into the urethra, giving rise to incomplete urinary obstruction. Later they returned to the cyst. This culminated in an attack of acute retention, and six stones were removed from the urethra. They were composed of calcium phosphate with some organic material.

The symptoms may be modified by such complications as peri-urethral abscess, extravasation of urine, and epididymo-orchitis. It may be possible to elicit a previous history of renal calculus, litholapaxy, stricture, etc.

Diagnosis.—The diagnosis is as a rule easy, for the stone is readily palpable if the course of the urethra is examined in the penis, perineum, or on rectal examination. Nevertheless the diagnosis is often overlooked until the stone is found on urethroscopy or at operation. This failure is undoubtedly often due to incomplete examination, for palpation of the urethra in

urinary disease is a clinical method not sufficiently stressed, and indeed is often omitted. Further, there is tenderness on pressure over the stone, and a stone erepitus may often be elicited in cases of multiple calculi. The passage of a bougie is usually helpful, as it may be held up by or felt to grate on a stone. This, however, is not infallible, as

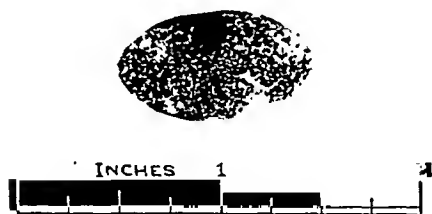


FIG. 219.—*Case 3.* Stone removed from a pouch in the floor of the urethra.

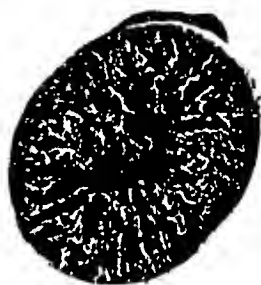


FIG 220.—*Case 3.* Section of stone shown in *Fig. 219* on a larger scale.

the bougie may fail to pass if a stricture is present, or it may be passed readily even in the presence of a stone as in the case recorded by Morton,³



FIG. 221.—*Case 3.* Pouch, with stone, outlined by lipiodol.

in which Lister's sounds were at first passed, but a few days later struck the stone and were held up. A stone lying in a pouch is especially liable to be overlooked. Urethroscopic examination will usually determine the

diagnosis unless the stone is hidden behind a stricture or in a pouch. Finally, radiology may be a valuable aid, particularly if combined with the injection of lipiodol, as this will show the exact relationship of the stone to the urethra.

Case 3.—A male, age 67, was admitted with lower abdominal pain and frequency of micturition by day and night. He had previously had two attacks of retention of urine, but otherwise there was no dysuria. A stone was palpable in the perineum. Urethroscopy showed many folds strictureing the urethra. This stone was composed principally of triple phosphate. Figs. 219-222 illustrate the condition.

TREATMENT.

Occasionally the passage of the stone results in a natural cure, but any pathological condition still remains to be treated. Again, in other cases the pressure of the stone causes the formation of a perineal fistula in the male or a vaginal fistula in the female, and through this the stone may escape. *Preventive treatment* consists in dealing with pathological conditions predisposing to the presence of a calculus in the urethra, such as the treatment of strictures, pouches, vesical calculi, etc. Care must be taken after the operation of litholapaxy that no small fragments are left in the bladder.

Treatment is either by emergency or deliberate methods, depending upon the severity of the symptoms. If there is no urgency, a complete investigation of the local and general conditions must be made, e.g., the condition of the urethra, the renal function, and the presence of other urinary calculi.

Minor Methods.—The following minor procedures are of use particularly when small stones are present:—

If urine is allowed to accumulate, the stone may be carried forward on micturition by the increased force of the stream thus obtained. The injection of oil, water, or air, combined with pressure behind the stone, results in dilatation of the urethra, and the stone thus becoming disengaged may be worked forward by gentle pressure with the fingers. In the past the injection of hydrochloric acid has been used with the idea of dissolving the stone.

Bixona's Method.¹²—This was originally successfully carried out by the surgeon upon himself. Preceding the impaction of the stone in the urethra he had had an attack of renal colic, and he considered that as the stone could pass along the ureter it should traverse the urethra and was probably being held by spasm. He injected cocaine to relieve pain and spasm; then, holding



Fig. 222.—Case 3. The bladder and urethra, with the pouch in the floor of the latter.

the meatus, he attempted to micturate, thereby distending the urethra. On releasing his hold the stone was carried forward and passed.

The Filiform Guide Method, used by Jacobs.¹³—This consists in the insertion of a number of filiform guides which become arranged around the stone, then gripping the projecting ends of the guides and withdrawing them together with the stone. I was able to apply this method successfully in a recent case.

Case 4.—A male, age 59, who had previously been operated upon for a malignant papilloma of the bladder, was attending the cystoscopy out-patient department for diathermy of a local recurrence. On Feb. 4, 1927, he complained of having had an attack of dysuria a week previously, followed by pain 'like a needle' in the penis, and a less severe pain at the end of the penis since. The presence of a stone $\frac{1}{2}$ in. within the meatus was confirmed by urethroscopy. As described above, whip guides were inserted, and a number of fragments shown in *Fig. 223* were withdrawn. The stone was composed of sodium and magnesium carbonates and phosphates.

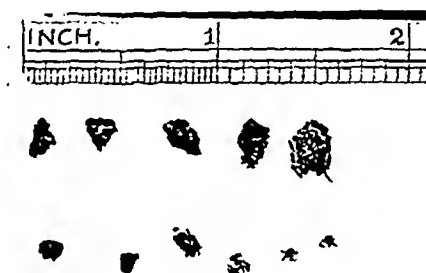


FIG. 223.—*Case 4.* Minute calculi removed by the filiform guide method.

Continuous Dilatation.—If a catheter can be passed, it should be tied in, and following its removal the stone may escape.

The Use of Instruments.—If the above methods have failed, the stone may be removed with the aid of urethral forceps or scoop passed, if considered helpful, through a urethroscope tube, the stone being fixed with the fingers of the left hand to prevent its being pushed back. This applies particularly to stones in the anterior urethra. If the stone is in the posterior urethra it may be pushed back into the bladder and there crushed. Silver wire snares have been employed to encircle the calculus and so remove it. Various types of urethral forceps and lithotrites have been devised from time to time, the latter dating back to very early days.

Operative Procedures.—If the above-mentioned methods fail or are obviously useless, operative procedures become necessary. The simplest of these is a meatotomy to release a stone impacted in the fossa navicularis. For stones situated behind the fossa an external urethrotomy will be necessary. If there is an associated stricture it may be treated at the same or a subsequent operation. If the stricture is solitary and localized, as shown by lipiodol injection, it may be divided by the external urethrotomy or excised. If there is more than one stricture or diffuse contracture of the urethra, an internal urethrotomy is indicated.

Stones in the prostatic urethra may, if large, result in great stretching of the prostate, and this organ may seem to have disappeared. A preliminary examination with lipiodol may be of value in ascertaining the relationship of the stone to the urethra and bladder, and so in deciding whether to approach by the perineal or suprapubic route.

After-treatment.—There is a tendency to recurrence of these calculi. Morton³ recorded a case in which a patient underwent six operations for the removal of recurrent stones. The dilatation of strictures, the removal of pouches, and investigation of the urinary tract for further calculi must be emphasized in order to prevent recurrence of the trouble. The possibility of atony of the bladder must not be overlooked.

I wish to express my gratitude to the Director, Dr. A. Russell Green, and to the Sister of the Radiological Department.

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A CASE OF COMPLETE GASTRECTOMY FOR CHRONIC ULCER: WITH OBSERVATIONS ON THE EFFECT OF THE LOSS OF THE STOMACH ON THE PHYSIOLOGY OF DIGESTION IN MAN.

By H. B. BUTLER,

HON. SURGEON TO THE ROYAL SURREY COUNTY HOSPITAL, GUILDFORD.

THE patient, G. B., age 42, was sent to the Royal Surrey County Hospital on Feb. 12, 1926. He had a four years' history of indigestion, the character of which suggested a gastric ulcer; moreover, an X-ray photograph clearly showed the crater of an ulcer high up on the lesser curvature. There was no hour-glass contraction of the stomach, pyloric stenosis, or obstruction in any part of the bowel.



FIG. 224.—Skiagram taken in the standing position. Second meal in stomach. (Nov. 19, 1926.)

It was agreed that the treatment to be adopted should be complete rest in bed, with the diet and medicines as recommended for gastric ulcer by Robert Hutchison.¹ This treatment was carried out by his own doctor at home and was very successful, the patient gradually making what appeared to be a complete recovery. He remained well until the middle of October, 1926, when the pain returned, though this time it was of a different character, being a continuous stabbing pain made worse by food. He vomited periodically, but there was no visible hæmatemesis or mælena.

His doctor immediately put him back to bed and gave him the treatment which had been successful on the former occasion, but this time with no success, the patient becoming

worse. After three weeks of such treatment I saw him again, and he was admitted into hospital. He was very weak and emaciated, but the X-ray examination (*Fig. 224*) revealed the same picture as before, the ulcer being in evidence and still no obstruction. The examination of the blood was as follows: red blood-cells, 3,200,000; hæmoglobin, 75 per cent; colour index, 1.2; white blood-cells, 6560; polymorphs, 75 per cent; small lymphocytes, 14 per cent, large lymphocytes, 9 per cent; eosinophils, 20 per cent.

forceps, but the blood-vessels had retracted out of the forceps and very free bleeding took place. Attempts to secure the bleeding vessels only made matters worse, so a large hot pad was placed behind the transverse mesocolon and another over the top of the bleeding area, and these were left in position while the operation was continued. After the stomach had been freed these pads were removed and the bleeding vessels were then easily secured. The transverse mesocolon, however, looked rather battered and bruised by the pressure it had been subjected to by the pads, so it was decided to bring the loop of jejunum up over the transverse colon to join with the œsophagus, rather than run the risk of further damage to the mesocolon by making a hole in it.

Pathological Examination.—The operation being completed, an examination was made of the stomach, and it was then thought that the diagnosis of malignancy was probably a mistaken one. The pathological report was to the effect that the condition was one of chronic gastric ulcer with catarrhal changes in the surrounding mucosa. There was no evidence of malignancy. The gastric mucous membrane was injected and had a covering of glairy mucus. It is probable that this glairy covering accounted for the hypochlorhydria, and the chronic gastritis which had caused it may also have had something to do with the failure of the medical remedies to promote improvement.

After-treatment.—The patient was very considerably shocked and caused some anxiety for the first twelve hours after operation. After that he made rapid progress to complete recovery. He soon began to enjoy his food and developed rather a large appetite. He left the hospital on Jan. 31, 1927, having put on more than a stone in weight since the operation. I saw him again on March 25, when he had gained nearly three stone and was anxious to return to his work as a shoemaker.

With a view to avoiding the Addison's anæmia from which four cases of total gastrectomy are known to have died, great care was and is being taken to avoid sepsis from the mouth. All his teeth had been removed before being first seen at the hospital, and he had been provided with well-fitting dentures. He had no discernible sepsis in his mouth or nose, but very strict instructions were given him as to the care of his mouth and dentures, which latter were to be carefully scrubbed with Milton after every meal and kept in this solution at night. On the advice of Dr. Arthur Hurst, he was recommended to take a teaspoonful of dilute hydrochloric acid in a tumblerful of milk, with a little sugar added, three times a day, to compensate for the loss of the normal acid secretion of the stomach and to prevent the contents of his bowels from getting too alkaline and thus promoting the development of bacteria, the toxins of which might cause anæmia. His work, as a mender of shoes, is a dusty and confined occupation, which cannot be the best for him, but it is difficult for a man more than 40 years old to change his occupation. Moynihan's celebrated case, after having his whole stomach removed for cancer, died nearly four years later from Addison's anæmia; and in a case recorded by Ellis a patient developed subacute combined degeneration of the spinal cord and Addison's anæmia in less than two years after a complete gastrectomy had been performed at the London Hospital.

PHYSIOLOGICAL OBSERVATIONS.

In May, 1927, the patient being in apparently good health, the following investigations were made:—

1. **Stools.**—The stools on a full diet were examined for excess of starch, undigested (i.e., striated) muscle fibres, excess of fat, or any abnormal organisms. The report was: A soft pale brown, semi-solid specimen, rather foul. Microscopical examination showed:—

a. *Starch granules* are only seen in quite moderate numbers and do not constitute an excess by any means.

b. *Striated Muscle Fibres* are only very little in evidence, and needed much search before one or two small bunches were found.

c. *Fat.*—The specimen contained 74.6 per cent water. The dried specimen contained:—

| | | | | | Normal |
|------------------------------|----|----|---------------|----|------------------|
| Free fatty acids | .. | .. | 25.0 per cent | .. | 9 to 13 per cent |
| Neutral fats | .. | .. | 5.3 | .. | 1 to 2 |
| Fatty acids present in soaps | .. | .. | 7.7 | .. | 10 to 15 |
| Total fatty extract | .. | .. | 38.0 | .. | 20 to 30 |

Cultures give no abnormal non-lactose-fermenting organisms.

2. **Barium Meal Investigation.**—The rate of arrival of food at the ileocecal sphincter and the rate of complete emptying of the ileum were investigated to ascertain whether any portion of the small intestine altered its function at all to become a new stomach.

At 11.30 a.m. on May 6, 1927, the patient was given a breakfastcupful of bread and milk, containing 4 oz. of barium sulphate. An X-ray film taken in the standing position shows a considerable dilatation of the jejunum at its junction with the œsophagus, the jejunum being sucked up under the left dome of the diaphragm, the upper part containing an air-bubble and making a very fair imitation of the fundus of the stomach: the barium meal rapidly circulating in iliac coils (Fig. 226). Five minutes later the distended portion of the jejunum still contained a mass of barium, the air-bubble still being much in evidence (Fig. 227).

One hour after the meal the barium had all accumulated in pelvic coils of the ileum (Fig. 228). An hour and a half after the meal the barium was still all in lower iliac coils (Fig. 229). Three, four, five, six, and seven hours after the meal no barium had appeared in the cæcum (Figs. 230-233). The patient, being now very hungry, was allowed to have a normal meal. At 7.30 p.m., eight hours after the barium meal, nearly the whole of the barium was in the cæcum, peristalsis having, no doubt, been stimulated by his much-desired meal (Fig. 234).

Twenty-eight hours after the barium meal, the patient having in the meanwhile passed a stool containing barium, the colon was still faintly marked out with barium (Fig. 235).

3. **Bacteriological Examination of Jejunal Contents.**—A clear bile-stained mucoid fluid with a good deal of white froth was withdrawn by means of Ryle's tube, and cultures on agar plates were made. Some short



FIG. 226.—Skiagram taken immediately after drinking barium meal. (11.30 a.m., March 6, 1927.)



FIG. 227.—Five minutes after barium meal.



FIG. 228.—One hour after barium meal.

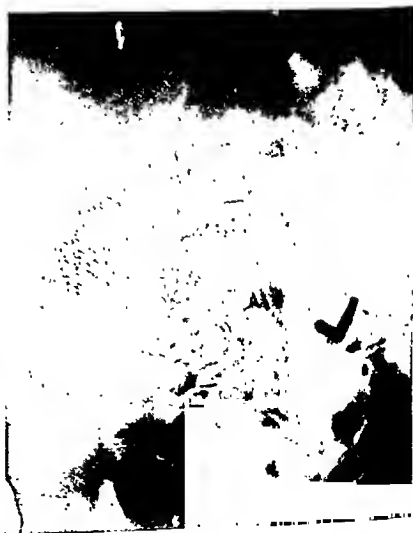


FIG. 229.—An hour and a half after barium meal.



FIG. 230.—Three hours after barium meal.



FIG. 231.—Four hours after barium meal.



FIG. 232.—Five hours after barium meal.



FIG. 233.—Six and a half hours after barium meal.



FIG. 234.—Eight hours after barium meal—
one hour after eating ordinary food.



FIG. 235.—Twenty-eight hours after early
and only barium meal. Normal food taken
during day.

fat streptococci were isolated, with a very few colonies of *Bacillus coli*. Broth cultures gave a few streptococci of the same type as above, but were smothered by *Staphylococcus albus*. A few *B. coli* were again recovered.

4. **Blood-count.**—The following is a comparison of the present blood-count with that taken before the operation:—

| | Before operation | At present |
|--------------|------------------|----------------|
| Total reds | .. 3,200,000 | .. 5,433,000 |
| Hæmoglobin | .. 75 per cent | .. 90 per cent |
| Colour index | .. 1.2 | .. 0.9 |
| Total whites | .. 6560 | .. 7500 |

Differential Count—

| | | |
|--------------------|----------------|----------------|
| Polymorphs | .. 75 per cent | .. 67 per cent |
| Small lymphocytes | .. 14 | 29 |
| Large lymphocytes | .. 9 | 2 |
| Eosinophils | .. 20 | 1 |
| Transitional cells | .. 0 | 1 |
| | 23 per cent | 31 per cent |

5. **Defæcation.**—Does he get his bowels opened as before? In other words. Has he got a jejuno-colic reflex in place of a gastro-colic reflex?

For some years before the operation he was very constipated and had no regular time for bowel evacuation. Now he gets an evacuation immediately on rising or directly after breakfast, more frequently directly after getting out of bed, having taken no food or drink; one large soft stool once a day.

6. **Hunger, Appetite, etc.**—He enjoys his meals and is able to eat all ordinary food. If he eats too large a meal, he experiences a feeling of

tightness in the epigastrium. He is quite definitely hungry, and has a feeling of emptiness if he goes without a meal, but he does not get hungry or empty sooner than other people. If asked *where* he feels his hunger, he places his hand over his epigastrium. He is not conscious of any alteration in his sensations of hunger or appetite.

CONCLUSIONS.

It is probable that the improvement in the blood-count as well as in his general health is merely due to the fact that he is no longer losing blood from a chronic gastric ulcer. The loss of the stomach as a machine for mixing, churning, and softening food before it enters the small intestine is apparently not a very serious matter, but the loss of the stomach secretions with their powers of sterilization is of much greater importance. "Knott has shown that achlorhydria not only allows the access of bacteria from the mouth to the duodenum, but, by causing an increase in the alkalinity of the small intestines, it permits bacteria to spread from the colon to the small intestines, the reaction of which normally inhibits their development. The consequent invasion of the duodenum with pathogenic strains of *B. coli* often leads to ascending infection of the biliary passages" (Hurst). It is interesting to note that this man had *B. coli* as well as streptococci in his jejunal contents, and I take this to be an indication to increase his dose of hydrochloric acid.

In answer to the question as to whether any part of the intestine has altered its function so as to become a new stomach, I should say that the portion of the jejunum immediately below the anastomosis with the œsophagus had to some extent done this. There is a decided dilatation which contains a quantity of barium for an appreciable time, and there is a false gastric fundus, developed from jejunum, which performs the duty of the real gastric fundus in accommodating a large bubble of swallowed air during the time when the 'new stomach' is full of food. It is true that the barium remained in the lower iliac coils for an unusually long time, but no dilatation of these coils was noticed, and they immediately emptied themselves into the cæcum when peristalsis was stimulated by taking more food.

The answer to the question whether a jejuno-colic reflex has taken the place of a gastro-colic reflex would appear to be 'No', but there is no doubt that taking food into the jejunum sets up a very brisk reaction in the lower iliac coils, corresponding with the normal gastro-ileal reflex of Hurst and Newton. Food which had remained in these coils practically motionless for seven hours was immediately passed on into the cæcum and ascending colon when more food was taken.

So far as the actual digestion of food is concerned, the patient appears to have no difficulty with either starch or muscle, but fat is in excess in his stools, though not to any serious degree. As it is almost all in the form of split fat, it is not likely to be due to pancreatic inefficiency.

It is probable that some food does go in the direction of the duodenum; indeed, I thought I could distinguish two streams of barium descending from the anastomosis when I was watching the descent of the meal through the

X-ray screen; but it is quite certain that a much greater part descends directly into the ileum.

It would have been interesting to have made choleecystograms to see if the bile concentrated normally in his gall-bladder, and particularly if the ingestion of a fat meal caused the gall-bladder to empty itself. At this stage, however, the man became wearied of investigations, and wanted to return to his work. I was obliged to let him go.

My thanks are due to Dr. Arthur Hurst and Dr. R. C. Matson, the former for suggestions as to the nature of the investigations which have been made, and the latter for carrying out all the pathological work.

REFERENCE.

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SHORT NOTES OF RARE OR OBSCURE CASES

RECURRENCE OF CARCINOMA OF THE STOMACH EIGHTEEN YEARS AFTER PARTIAL GASTRECTOMY.

By ERIC PEARCE GOULD,

SURGEON TO OUT-PATIENTS IN THE MIDDLESEX HOSPITAL, LONDON.

W. B., male, age 58, was admitted to the Middlesex Hospital under the care of Dr. Pasteur in January, 1907, complaining of epigastric pain of four weeks' duration.

Examination revealed a freely movable mass in the epigastrium, to the right of the middle line. The patient's general condition was good, and the diagnosis of carcinoma of the stomach having been made, he was transferred to the care of Sir Alfred Pearce Gould. The following is the record of the operation performed on Feb. 9, 1907:—

"An incision 6 in. in length was made just to the right of the middle line through the right rectus. The bottom of the incision was $\frac{3}{4}$ in. below the level of the umbilicus.

"The abdominal cavity was opened and a growth was found extending round the pyloric end of the stomach. No glands could be felt. The first part of the duodenum was then clamped in two places, and the gut divided between them. The distal end of the duodenum was closed by a double row of sutures. The coronary and right gastro-epiploic arteries were then ligatured, and the gastro-hepatic omentum and part of the great omentum cut through. Clamps were placed across the stomach well above the growth, and the stomach divided between, the proximal end being closed with a double row of sutures. A posterior gastro-jejunostomy was then done, and the wound closed and dressed with gauze.

"The growth, about $2\frac{1}{2}$ in. in diameter, involved principally the anterior surface of the stomach and did not quite reach the pylorus. It was circular, well circumscribed, and consisted of one large ulcer with a much-thickened nodular base, and thickened everted edges considerably raised above the level of the stomach mucous membrane. The posterior surface of the stomach was only slightly adherent."

Pathological Report.—Spheroidal-celled carcinoma.

Apart from the development of a duodenal fistula, which closed spontaneously, the patient made an uneventful convalescence, and left hospital on March 15.

Nothing further was heard of him until he came to my out-patient department on Sept. 15, 1925, complaining that, having been quite well until February—that is, eighteen years after the operation—he then began to have pains in the stomach and to be short of breath. The man, now 76 years of age, was vigorous but anæmic. Abdominal examination revealed

a soundly healed laparotomy scar, and to the left of it a somewhat indefinite mass which was dull on percussion, moved with respiration, and was not tender. A barium meal gave the picture of a gastro-enterostomy with a small stomach cavity. The blood-count showed a pronounced degree of

secondary anaemia. The patient declined to come into hospital, but was seen from time to time, up to December, 1925, without any obvious alteration in his condition.

He was not seen again until June, 1926, when the tumour to the left of the middle line was found to be greatly increased, forming a prominence extending from the costal margin down to the navel, and to the right of the mid-line. He had lost flesh and his anaemia was more pronounced,

but he was still taking his food without pain. His chief complaint was of weakness. He was admitted to the hospital on July 15, and slowly sank, dying on Aug. 9. He slept for most of the time that he was in hospital, and on no occasion

required sedative drugs for pain. The following is an extract from the post-mortem record:—

"Both lobes of the liver were greatly enlarged by numerous soft, secondary new growths, the largest of which was 4 in. in diameter. Previous partial gastrectomy, with gastro-jejunosomy patent. The remaining portion of the stomach was occupied by a large fungating mass of new growth which left little healthy mucosa. The mass of the growth was adherent

to the under surface of the left lobe of the liver, and continuous with the deposit in that organ. The head of the pancreas and the middle portion of the body were also extensively infiltrated. The growth within the stomach stopped short at the junction of the jejunal mucosa, which junction was

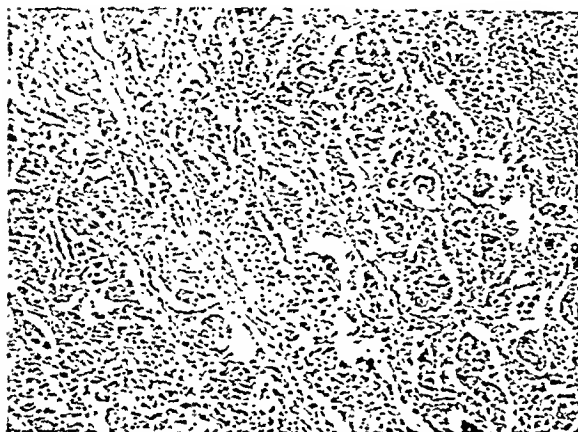


FIG. 236.—Primary tumour. ($\times 75$.)

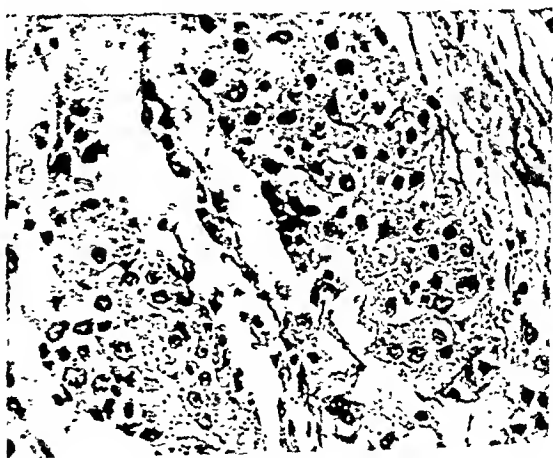


FIG. 237.—Primary tumour. ($\times 350$.)

thus sharply demarcated. Enlarged glands were present in the neighbourhood of the stomach and on either side of the abdominal aorta, but no glandular or other recurrence was found elsewhere in the body."

Sections of the original tumour (*Figs. 236, 237*) show diffuse infiltration of the muscles and connective tissue by columns of spheroidal-celled carcinoma. The cells of the growth have slightly granular protoplasm, and distinct cell outline; the nuclei are fairly constant in size and staining, and each possesses a prominent acidophil nucleolus. No attempts at tubule formation could be detected.

Sections taken from the edge of the tumour found in the stomach at the post-mortem (*Figs. 238, 239*) show invasion of the surrounding tissue by strands and masses of carcinoma. The cells of the growth have clear protoplasm and indistinct cell outline. The nuclei vary much in size, shape, and depth of staining. The larger nuclei are less densely stained and show a prominent nucleolus. Portions of the growth show attempts at tubule formation.

The difference in the histological character of the two tumours naturally raises the question as to whether the second is a recurrence of the first, or whether the second is not, in fact, a true second primary carcinoma in the same organ. Whilst admitting that the histological differences, although definite, are slight, and would not in themselves justify acceptance of the second of the above alternatives, I feel that the clinical history of the case strongly supports this view. Unlike carcinoma of the breast, in which disease the period of freedom

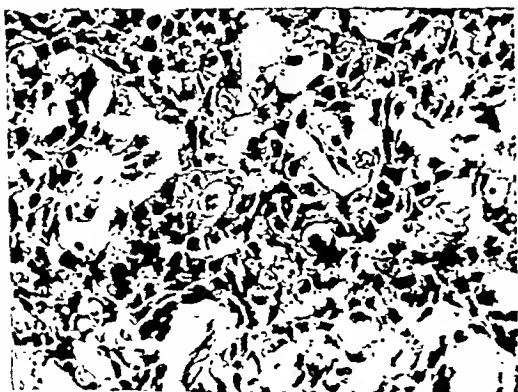


FIG. 239.—Tumour found post mortem. ($\times 350$.)



FIG. 238.—Tumour found post mortem. ($\times 75$.)

from recurrence not infrequently exceeds 10 or even 15 years, clinical experience suggests that recurrence after removal of a carcinoma of the stomach occurs, if at all, within a 5-year period, although probably few cases of this kind have been followed for as long as 18 years. To this, the most important consideration in favour of looking upon the case as an instance

of a second primary cancer in the same organ, must be added the fact that, whilst the first tumour took the form of a shallow ulcer with everted indurated edges, the second was of the free-growing fungating type.

The chief interest of the case, however, lies in the remarkable prolongation of healthy life which resulted from the operation performed in the early days of partial excision of the stomach. It suggests also the value of an efficient gastrojejunostomy in lessening the pain usually associated with a rapidly advancing gastric carcinoma.

I am indebted to Professor J. MacIntosh and his staff in the Bland-Sutton Institute of Pathology for identifying the block of tissue embedded after the original operation, for cutting further sections from this block, and for reporting upon these and sections made from the tumour found in the stomach post mortem.

A LATE RESULT IN ECTOPIA VESICÆ.

By F. N. G. STARR,

ASSOCIATE PROFESSOR OF CLINICAL SURGERY IN THE UNIVERSITY OF TORONTO.

WHEN I read the notes of the case reported by Drs. Foulds and Robinson,¹ showing the late result in one of the cases of ectopia vesicæ operated upon by the late George A. Peters, it occurred to me that the case of a man living in New York State might also be of interest.

This man, when a boy 11 years of age, had been brought to Dr. Peters' house on the day of the doctor's funeral, having previously experienced in New York City three unsuccessful attempts to make a bladder. The case was referred to me, and on May 11, 1907, I transplanted both ureters into the rectum by the method described by Peters. On the right side the cuff slipped out of the rectum, but the other worked perfectly, and a month later I transplanted the one that had slipped. His condition was not good at this time, and I did not ablate the remainder of the mucous membrane of the bladder, expecting to do that about a year later. He did not return until September, 1916, when I removed the mucous membrane of the bladder, and swung a flap of skin to cover the raw surface.

On May 28, 1926, he returned to see me, having developed a small inguinal hernia on the left side. Except for this he is in perfect health, he has no inconvenience from urine, and his sphincter ani muscle acts perfectly, even during sleep. Another striking thing is that the space between the symphysis pubis has become considerably narrower. He is at this time a young man of 30, carrying on as a commercial traveller, covering the New England States.

REFERENCE.

¹ *Brit. Jour. Surg.*, 1927, xiv, 529.

A CASE OF OBSTRUCTION DUE TO A MECKEL'S DIVERTICULUM.

BY MAJOR C. M. FINNY, R.A.M.C., MALTA.

THE following case appears worthy of being recorded as it presented several features that were unusual from both a pathological and a clinical standpoint.

J. S., a Maltese soldier, age 19, was admitted to hospital at 5 p.m. on April 26. He stated that he had been seized with severe abdominal pain on the 25th, and had vomited several times. The pain was centred round the umbilicus, but at times involved the whole abdomen. He felt compelled to micturate very frequently, but could only pass a few drachms at a time. There was no distention or rigidity of the abdomen, though he complained of tenderness all over it. His temperature was 98°, pulse 56. He was very restless and noisy during the night; and though he tossed about and once got out of bed, he appeared to find most ease lying on the right side. He vomited several times.

I was asked to see him the following morning. His temperature was still 98°, but his pulse-rate had increased to 94. Breathing was thoracic in character, and all the abdominal muscles were held rigid. He complained of tenderness all over the abdomen, but most marked just to the right of the umbilicus. Immediate operation was advised.

A right paramedian incision was made below the umbilicus, and on opening the abdomen serous fluid escaped. Search revealed a greenish cystic tumour, the size of a small hen's egg, which emitted a foul and fishy smell. It appeared to spring from the superior aspect of the mesentery, not far from its root. It was brought up to the parietal wound with difficulty, when its neck was found to be constricted by a tubular structure about $\frac{1}{2}$ in. broad and resembling a large appendix. The adjacent portion of small intestine was constricted by the same structure, and for a distance of about 10 in. was dilated and of a deep plum colour.

The tube was divided between forceps, with prompt relief to the gut. One end was found to be twisted tightly round the neck of the cyst and to be attached to the ileum about 30 in. from the ileocaecal valve. It was removed from the bowel, and the opening in the latter closed with Lembert sutures. The other end of the tube was traced to the inferior aspect of the mesentery, through which it was found to be continuous with the cystic swelling. The latter, being now free, was removed, and the abdomen closed without drainage. The patient made an uninterrupted recovery.

The Meckel's diverticulum was found to measure 6 in. in length. The free end was bulbous and showed a marked constriction at the junction of its proximal and middle thirds. The portion beyond this was gangrenous.

Meckel's diverticulum is a well-recognized cause of intestinal obstruction, particularly when its distal end is attached to the umbilicus by a cord-like remnant of the vitelline duct. In this case the obstruction was due to the tube knotting itself round the bowel (*Figs. 210, 241*). To do this the free end had first to pass through the mesentery, and then through a loop of itself. The knot formed was tight enough not only to obstruct the bowel, but to strangulate the distal end of the diverticulum.

It seems impossible to account for the position assumed by the vestigial organ on embryological grounds. The vitelline duct is developed before the mesentery and is attached at both ends. It is possible that a developmental defect may have existed in the mesentery through which the free extremity

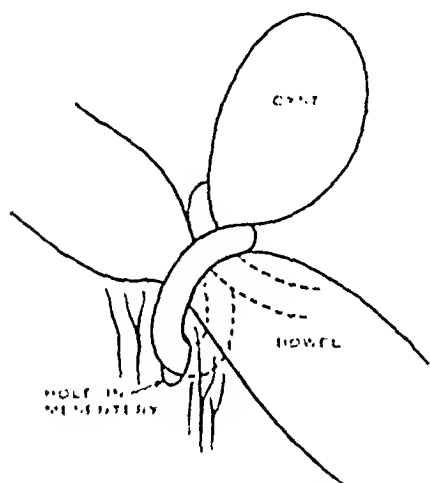


FIG. 210.—Diagram showing relation of diverticulum to bowel and mesentery.

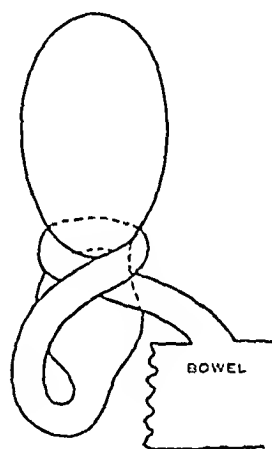


FIG. 241.—Diagram showing knot tied by diverticulum.

of the diverticulum passed, and was assisted by movements of the intestines to assume its final complicated position.

From the clinical point of view, the patient's first symptoms were evidently due to the intestinal obstruction, which was later complicated by commencing inflammation round the gangrenous extremity of the offending diverticulum. His urinary symptoms were probably due to irritation of the ureter at the point where it passed behind the peritoneum inflamed by contact with the gangrenous sac.

It is interesting that even on the third day of the illness there was no pyrexia—a good example of a serious abdominal condition coexisting with a normal temperature.

PERFORATION OF A MECKEL'S DIVERTICULUM.

BY J. ALLAN BERRY, NEW ZEALAND.

THE strangulation of intestines by a band attached to the tip of a Meckel's diverticulum, and its presence in herniæ, are comparatively common, but cases of acute inflammation due to a foreign body appear to be extremely rare. One of the latest cases recorded is that of Dr. Christopher,¹ of St. Luke's Hospital, where the diverticulum was perforated and the result was peritonitis. The reason why a diverticulum of this sort does not more commonly give rise to trouble is its wide opening into the bowel, an opening which is often the same width as that of the bowel. The following case of this unusual condition seems rare enough to warrant its being recorded:—

F. B., male, age 36, was admitted to the Napier Hospital, New Zealand, on Sept. 4, 1923, as a case of acute appendicitis. His previous health had been excellent. The pain commenced thirty hours previously in the right iliac fossa, and was relieved by hot applications. There was no vomiting, but the patient complained of nausea. On the morning of the day of admission, micturition was accompanied by pain, and the same occurred on defæcation. Temperature normal, pulse about 90.

ON EXAMINATION there was generalized tenderness over the lower abdomen, most marked at McBurney's point. The cutaneous hyperæsthesia seen in acute appendicitis was well marked. Rectal examination showed tenderness, particularly noticeable on the right side. The urine was normal, and the number of leucocytes was high. A diagnosis of acute appendicitis with some peritonitis was made.

OPERATION.—On opening the abdomen, seropurulent fluid escaped. The appendix was found to be normal, but an acutely inflamed perforated Meckel's diverticulum was found between two and three feet from the ileo-cæcal junction. This was resected, but as there appeared to be some narrowing of the gut it was decided to resect part of the ileum. This was done, and an end-to-end anastomosis performed. The abdomen was drained for a day or two.

Recovery was uneventful, and the patient was discharged on Sept. 29, a little more than three weeks after admission.

On examination of the diverticulum, which measured about an inch in length, and at its base had about the same diameter, it was found to be perforated by a small piece of wood, apparently a piece of a skewer used for holding meat together.

REFERENCE.

¹ CHRISTOPHER, *International Clinics*, Series xxxv. i, 67.

A CASE OF DIAPHRAGMATIC HERNIA.

By R. F. JOWERS,

CONSULTING SURGEON TO THE ROYAL SUSSEX COUNTY HOSPITAL, BRIGHTON.

L. E., age 7, was convalescing from influenza, having had some vomiting and pain in the earlier part of the attack. At 1 p.m. on Feb. 9 he was seen by Dr. Fawcett, of Lewes, and was then quite comfortable. The abdomen was examined, and nothing abnormal was discovered. During the afternoon the child complained of 'stomach-ache', for which a carminative draught was given. This afforded no relief; the child vomited after his tea, and the pain became more severe and paroxysmal. Dr. Fawcett was again sent for, and found a definite lump in the abdomen lying to the left of the middle line a little below the level of the umbilicus. He diagnosed probable intussusception. I saw the child with him at 9 p.m. The abdomen was unusually flat, except for a definite tumour behind the left rectus, which was rigid. There was slight tenderness only. Nothing was felt per rectum, and no slime or blood had been passed. The patient's bowels had been open very slightly in the morning, but had acted well the previous day. He had vomited several times. Pulse 100, temperature not raised. Agreeing with the probability of intussusception, I advised immediate operation and had the child removed to Brighton.

At 11 p.m. Dr. Fawcett gave an anæsthetic, and I opened the abdomen over the left rectus, the centre of the incision opposite the umbilicus. A dark mass appeared, which proved to be the upper end of the spleen. The incision was enlarged, and the spleen, attached by a long narrow pedicle containing the vessels, and with its edge anterior, was lifted out and laid on the upper abdomen. The pedicle had been twisted once and a half, but the artery was palpable. It was then found that the stomach and duodenum were greatly distended, and the only bowel visible was the descending colon and sigmoid. On raising the stomach a coil of small intestine was seen, and on gentle traction the cecum and transverse colon came into view, being drawn from an opening in the diaphragm. The ileum was then traced upwards, and collapsed small intestine drawn from the diaphragmatic opening until the duodenum was reached. The child being in poor condition after influenza, and having been some time under the anæsthetic, no attempt was made to close the opening beyond placing the spleen into its normal position, which was just below the opening.

After some vomiting on the day after the operation, the child made steady progress, and by the end of a fortnight was singing and perfectly bright. On Feb. 25, however, he had severe pain in the abdomen, and the air-entry at the base of the left lung was not so good as that of the right. He lay on his right side, and complained of pain if moved on to his back or left side. The next day he was X-rayed by Dr. Prowse, who reported that coils of intestine could be seen above the diaphragm on the left side.

On Feb. 28, under intratracheal anæsthesia, Dr. Fawcett assisting, the

abdomen was reopened through the previous incision, which was extended upwards, and the left rectus divided transversely below the costal margin. The cæcum was found in the iliac fossa. A very long appendix was clamped and removed, and a suture inserted to anchor the cæcum in position. The stomach and a coil of ileum were adherent to the anterior abdominal wall in the region of the incision. A considerable amount of jejunum was found to have passed through the diaphragmatic opening and was easily drawn back, but some difficulty was experienced in freeing the opening of adherent gastrocolic omentum.

The diaphragmatic opening was found to be well to the left, the chest wall forming the lateral boundary, and situated just above the spleen, which had to be dislodged to reach it. A suture was passed through the edge of the



FIG. 242.—Skiagram showing the condition before the second operation.

opening and the chest wall, and some additional sutures through the phrenicocolic ligament and the diaphragm to close the remainder of the opening. This closure had to be performed very hurriedly, as the anæsthetist reported the child to be very bad and requested me to finish as quickly as possible. The abdomen was therefore rapidly closed. Though somewhat collapsed when returned to bed, the child made an uninterrupted recovery, and there has been no return of any symptoms up to the present time.

The skiagram (*Fig. 242*), for which I am indebted to Dr. Prowse, shows the condition before the second operation.

The ideal approach in a case of diaphragmatic hernia would be through the chest wall as described by Le Quénu, but in view of the very long appendix and mobile cæcum, noted at the first operation, I thought in this case it would be better to reopen through the previous incision.

A DOUBLE GALL-BLADDER REMOVED BY OPERATION.

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ANOMALIES of the gall-bladder are of rare occurrence, and yet several have been described, from the absence of any to the presence of multiple gall-bladders. From the developmental standpoint one would expect a larger percentage of abnormalities, as the gall-bladder is developed as an outgrowth from the primary hepatic diverticulum; this outgrowth is sometimes bifid, giving rise to complete division into two or subdivision of the fundus. The first recorded case in which a double gall-bladder was removed at operation was that of Sherren, who in 1910 operated upon a woman, age 25, and removed the specimen (No. 561.31) which is now in the Royal College of Surgeons of England. Schachner in 1914 operated upon a woman of 52 for cholecystitis, and discovered a double gall-bladder and drained both sacs.

The case described below is of interest because the smaller gall-bladder contained numerous gall-stones, while the larger one contained none. A preliminary X-ray picture was taken, and demonstrated the presence of gall-stones; a cholecystogram would have been of interest, as it might have shown the outline of both gall-bladders.

HISTORY.—Mrs. M. T., age 56, first came to the out-patient department of King's College Hospital in 1923 complaining of 'pains in her stomach' which she had noticed for quite five years previously. The patient was fat and weighed over 15 stone. On examination the abdomen was pendulous and the amount of adipose tissue in the abdominal wall was enormous. There was some tenderness in the right hypochondrium on deep palpation, but this was not very definite. The rest of the general examination revealed a thickened descending colon and a loaded sigmoid colon, which was aggravating some prolapsed internal piles. There was marked oral sepsis, which was treated; numerous roots were removed from the upper and lower jaw and the patient was fitted with upper and lower dentures. The internal piles were treated palliatively and the constipation was corrected. After two months' treatment the patient had lost all her pain, her bowels were acting regularly, and there was no sign of any hemorrhoids.

Nothing further was seen of the patient until March, 1924, when she again came to the hospital complaining of 'pains in the stomach' which were very similar to the former ones. On examination of the abdomen very little was to be found except some deep tenderness in the right hypochondrium. The patient was given a barium meal. The stomach was found to be normal, and was empty in four hours; the duodenal cap was badly formed and appeared to be pulled in an upward direction, and there was a suggestion of some small outlines thought to be gall-stones; the rest of the alimentary tract was normal. The patient was admitted to hospital on May 3, 1924, and drastically purged for three days, after which an X-ray picture of the gall-bladder area was taken. The skiagram (Fig. 243) revealed the presence of numerous gall-stones in a moderately enlarged gall-bladder. The day after

the skiagram was taken the patient began to complain of pain in the right shoulder and was slightly jaundiced: whether the drastic purgation had anything to do with this it is difficult to say.

OPERATION (May 10, 1924).—Under chloroform and ether anaesthesia the abdomen was opened through the upper part of the right rectus muscle. After incising the peritoneum and retracting the rectus muscle, the fundus of the larger gall-bladder presented at the bottom of the wound. On placing the right hand inside the abdomen the smaller gall-bladder containing

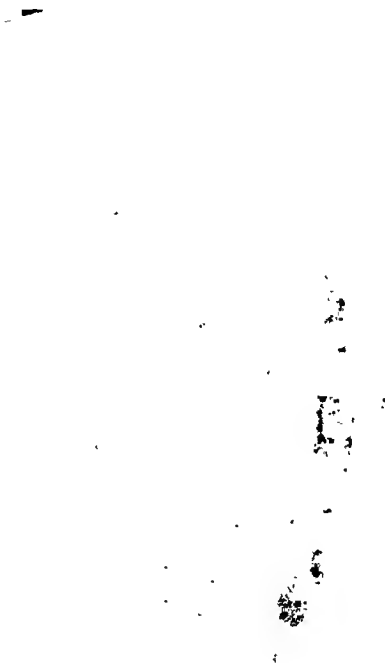


FIG. 243.—Skiagram of double gall-bladder, showing numerous stones in the smaller bladder.

numerous stones could be felt. At first I thought it was a large diverticulum of the gall-bladder. The general peritoneal cavity was packed off with gauze, and removal of the double gall-bladder was performed. The operation was quite easy; the small gall-bladder was more adherent to the under surface of the liver than was the large, owing to inflammation consequent on the chronic cholecystitis. The cystic duct and artery were ligatured separately; a small drainage tube was inserted down to the gall-bladder fissure and the abdomen closed in layers. The drain was removed after three and the stitches after ten days.

Recovery was uneventful. When seen last in 1926, over two years after the operation, the patient was very well, had experienced no more attacks of pain, and her indigestion had vanished.

The specimen was placed in 10 per cent formalin solution directly after the operation and fixed for six days. The cut end of the cystic artery was isolated and traced by fine dissection up the cystic duct; it was found to divide into two parts about half an inch above the place where the main trunk was ligatured. The branches were distributed to the two gall-bladders. A window was cut into both gall-bladders. The wall of the smaller one was very thickened, and the mucous membrane inflamed (Fig. 244). The wall of the larger gall-bladder was only a quarter as thick as that of the smaller one; there were no stones inside the cavity. The stones were removed, and the necks of the bladders incised to demonstrate the relations of the cystic duct. A small calculus was found in the neck of the smaller sac; this was impacted, and was no doubt the cause of the gall-bladder colic. The duct of the larger sac opened obliquely into that of the smaller one, so that there were two cystic ducts for about half an inch, and then a common cystic duct for about half an inch. The two sacs were completely blended over the proximal third of their extent, while they were quite free for the distal two-thirds.

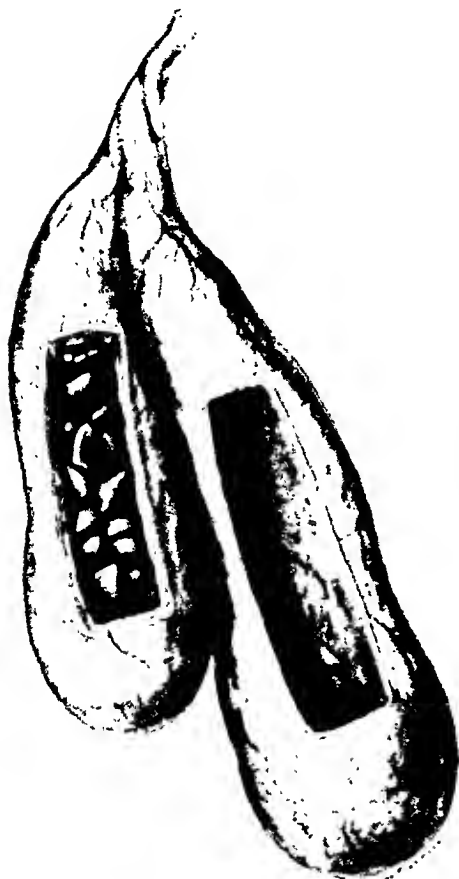


FIG. 244. Double gall-bladder: window cut in each organ.

It may be thought that this was a variety of bifid gall-bladder, but as two cystic ducts are present I consider that it is a variety of double gall-bladder.

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AN UNUSUAL CASE OF UMBILICAL HERNIA IN AN INFANT.

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B. D., age 1 month, was brought to the hospital on May 1, 1927, with what appeared at first sight to be a prolapse of large intestine lying on the skin of the anterior abdominal wall through a rupture of the umbilicus, after a fit of crying.

HISTORY.—The history given was that, after the cord had fallen off, the midwife had applied 'blue stone' daily to the navel as it would not heal. Half an hour before admission to hospital the mother had noticed the present condition.

ON EXAMINATION.—The child was apparently not in pain, had not vomited, and his general condition was very good. On closer examination

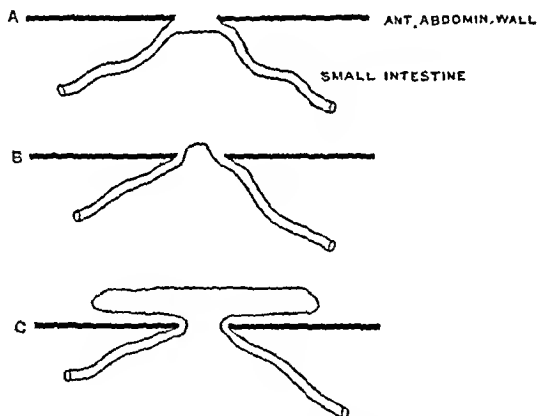


FIG. 245.—Diagram to show: A, Ulceration at umbilicus into adherent small intestine; B, The first stage of prolapse of mesenteric border; C, The prolapse complete, and forming a sac communicating with the general peritoneal cavity.

it was noticed that the mass was bicornuate in shape and attached by a single pedicle protruding about $\frac{1}{4}$ in. beyond the skin level at the umbilicus. Each cornu was about $2\frac{1}{2}$ in. long and 1 in. in diameter, lying at right angles to the pedicle and parallel to the surface of the anterior abdominal wall. Their direction was roughly in the long axis of the body and they were pointing in opposite directions. The pedicle was midway between the tips of the two cornua. The surface was smooth and of dark plum colour.

OPERATION.—After irrigating the hernia with saline, an incision was made just to the left of the pedicle and the peritoneal cavity opened. Coils of normal small intestine were seen entering the pedicle and filling the two cornua. These coils were reduced, and when the last coil had come through a fold of mesentery was seen passing up into the pedicle. The pedicle was

gently freed from the surrounding abdominal wall, and when this mesentery was pulled the sac of the hernia everted, leaving a dilated segment of small intestine with an opening on its antimesenteric border large enough to admit an ordinary pencil. This opening was closed transversely by two layers of Lembert sutures, and the abdomen closed.

The infant made an uninterrupted recovery except for a subcutaneous abscess at the site of the incision. Unfortunately he developed acute gastroenteritis six weeks later and died.

The explanation of this condition is, I think, that the application of the copper sulphate had gradually destroyed the abdominal wall at the site of the umbilicus. A coil of small intestine became adherent as a result of the local irritation, and eventually the caustic had destroyed one wall of the adherent intestine (*Fig. 245, A*). The mesenteric border then prolapsed through the opening (*B*), with its mucous membrane on the outer surface. Finally, it dilated as the coils of small intestine passed into this sac, and formed the bicornuate mass (*C*).

There was no question of a Meckel's diverticulum, as there was no suggestion of a stump, and apparently the coil involved was too far from the *cæcum* for this, nor had there been any previous discharge, fecal or otherwise.

REVIEWS AND NOTICES OF BOOKS.

The Treatment of the Acute Abdomen, Operative and Post-operative. By ZACHARY COPE, B.A., M.D., M.S. (Lond.), F.R.C.S., Senior Surgeon to Out-patients, St. Mary's Hospital, etc. Pp. 238, with 146 illustrations. 1926. London: Humphrey Milford. 10s. 6d. net.

THIS book is a companion and a complement to *The Early Diagnosis of the Acute Abdomen*. It is written mainly for the guidance of the practitioner who, though not generally practising surgery, may occasionally be called upon to treat a case of an acute abdominal catastrophe.

The first chapter is devoted to the description of the instruments and dressings likely to be wanted when operating on cases of this type. It contains many clear drawings of instruments and appliances generally used. The author favours the use of catgut generally as opposed to silk and thread. This more especially applies to cases dealt with in this book, as most of them have at any rate an element of sepsis, and for that reason unabsorbable materials are better avoided. The section on the thorough preparation of the hands, even when rubber gloves are worn, is of the greatest importance, and raises a point which is not always appreciated by surgeons whose operative experience is limited.

The opening sentence in the chapter on the treatment of acute appendicitis is one with which we thoroughly agree and which cannot be too strongly emphasized. If this advice is followed, many lives will be saved and prolonged illnesses due to an appendix abscess will be avoided.

Under the heading of 'Anæsthetics' the contra-indications to the use of chloroform in children are given. We would rather have seen, in a book of this kind, the indications, if there be any, for the use of chloroform for any patients suffering from a septic condition such as acute appendicitis. The removal of the appendix in cases of abscess only if it can be done without much disturbance of the surrounding parts is good advice. Many cases must have died as a result of the removal of an appendix from the wall of an abscess when simple drainage with perhaps removal of the appendix later would have led to recovery. In the same way rectal drainage in suitable cases is not performed as often as might be.

In the chapter on perforated gastric and duodenal ulcers the question of abdominal irrigation is discussed, and the author says that he has not seen many cases in which he thought it advisable. The general feeling is, we think, against irrigation. The number of cases, too, requiring drainage is undoubtedly diminishing. Gastro-enterostomy should only be done in cases in which the condition of the patient warrants a prolongation of the operation. It is by no means always necessary for his future comfort, as many ulcers which have perforated and have been sutured give rise to no further trouble. As the book is specially written for practitioners who have not had great experience in abdominal work, we think it is better to advise against gastro-enterostomy in these cases.

In the chapter on acute intestinal obstruction the danger of the aspiration of foul vomit into the airways is emphasized. This risk can be greatly diminished by washing out the stomach before the administration of the anæsthetic in all cases in which there is severe vomiting.

The chapter on acute cholecystitis is well illustrated by useful diagrams. The operation of partial cholecystectomy, though rarely called for, is one of considerable use in certain cases. We do not think that the advice to operate at the earliest convenient time on cases of acute cholecystitis will be generally accepted. The

condition is hardly comparable to acute appendicitis, as perforation and gangrene are far less common in the former than in the latter. Moreover, operation on an acutely distended and inflamed gall-bladder, frequently surrounded by thin bleeding adhesions, is a formidable undertaking, and the very great majority of these cases will quiten down without operation and may then be operated upon with much greater safety in the interval period.

The chapters on after-treatment, and especially those on diet and the care of the bowels, are among the most useful in the book. After-treatment is, unfortunately, usually neglected in the average text-book. It is a most important subject, especially to the practitioner who may be left to take care of the case after the surgeon has operated upon it.

We can recommend the book to all practitioners who may be called upon to operate in an emergency, and to house surgeons and junior surgeons, who will undoubtedly find many useful hints and much valuable guidance in its pages.

The Early Diagnosis of the Acute Abdomen. By ZACHARY COPE, B.A., M.D., M.S. (Lond.), F.R.C.S., Senior Surgeon to Out-patients, St. Mary's Hospital, etc. Fourth edition. Pp. 237. xiv, with 30 illustrations. 1927. London: Humphrey Milford. 10s. 6d. net.

THAT four editions of this work have been issued in the last six years shows that the book has proved of both value and interest to many readers. The present edition contains a new section dealing with mesenteric thrombosis and embolism which was omitted from the former ones. Although this condition is rare, it does occasionally occur and is only exceptionally diagnosed correctly before operation. We would have welcomed a little more help in this direction.

There are two new diagrams in the fourth edition, one showing the sites of pain referred to the back of the body in acute abdominal conditions, and the other the different positions in which appendix abscesses may occur.

We are still in disagreement with the author's 'stage of primary shock' in cases of perforation of a duodenal ulcer. We have yet to see a case of perforation of a duodenal ulcer which in its earliest stages shows a rapid pulse and lowered blood-pressure. If this stage does occur at all, it must certainly only last a few moments; we have never seen it persist for an hour or two. Apart from this the principal symptoms of acute abdominal disease are clearly outlined, and the book must have already proved of very great assistance to many who have to deal with these formidable cases.

The letterpress is clear, and the diagrams are devoid of all unnecessary elaboration. It is a work that can be thoroughly recommended to all who are likely to be called upon to deal with cases of this kind.

The Operations of Surgery. By R. P. ROWLANDS, O.B.E., M.S. (Lond.), F.R.C.S., Surgeon to Guy's Hospital, and Lecturer on Surgery to the Medical School; and PHILIP TURNER, B.Sc., M.S. (Lond.), F.R.C.S., Surgeon to Guy's Hospital, and Lecturer on Surgery to the Medical School. Seventh edition. Medium 8vo. Vol. I, pp. 1046, the Upper Extremity, the Head and Neck, the Thorax, the Lower Extremity, the Vertebral Column; Vol. II, pp. 896, the Abdomen. With 900 illustrations, 43 in colour. 1927. London: J. & A. Churchill. £3 10s. net.

It is some years since this well-known work was revised, though reprintings have been called for. The original Jacobson and Rowlands satisfied a want in a way which no other book has quite succeeded in doing since. It immediately became the stand-by of the active surgeon in the early years of his career, and a book of reference for the more experienced in which he could read the actual accounts of some of the rarer operations which have been performed. It was this general plan of describing real cases which added so very much to the interest of the book and enhanced its

value. The present authors have striven to maintain the unique characters of the original book whilst bringing it thoroughly up to date. They have had before them an exacting ideal, but have succeeded in approaching it very nearly. There are a few imperfections but no gross faults. In the realm of orthopædies there are, in spite of the authors' statements in the preface, numbers of operations described which the general surgeon is seldom called upon to do, whilst others, possibly more frequently required, are omitted. It would have been well worth giving as much attention to orthopædies as to other operative measures.

The critic reading the book gets an impression now and then that the authors occasionally get their values wrong in their selection of what to include and what to expunge. It is interesting to read Matas' account of ligation of the abdominal aorta, and there was no other way of referring to this rare operation than to quote the original author in full; but, on the other hand, the description of interventions upon the pituitary is inadequate. Such operations are more frequently required than the former, and do bring considerable relief to the patient. Eight pages are given over to methods of nephropexy—surely too liberal an allowance for such a rarely performed operation. Too much space also is devoted to operations for fixing the prolapsed stomach and intestines. This section could well have been left out altogether, or only mentioned to be condemned. Lymphangioplasty by silk threads is described fully and figured, though the procedure is generally admitted to fail in its achievements and is not now performed, whereas Kondoléon's method, from which more can be expected, has been omitted. An account of transfusion by defibrinated blood seems called for. It is the simplest of all methods. The statement that removal of the prostate by the perineal route is more likely to be piecemeal than by the suprapubic is not correct—in fact just the opposite is the case. But the authors sum up very fairly and judiciously the merits of the two operations. This may he said with added emphasis of the account of excision of the rectum for carcinoma. They argue very fairly upon the relative merits of the different methods, and we think present the position most justly. The illustrations are on the whole very good, though it is easy to pick out some, such as Figs. 232 and 255, which do not truly represent the appearances the surgeon actually meets at his operation. Pure diagrams as a rule are much more useful than attempts at realistic art.

Such small blemishes and other small omissions are of little consequence. The general character of the book has been preserved. It remains the best guide we know of for the less experienced surgeons, and in its new form is likely to make as wide an appeal as ever. We congratulate the authors on the strikingly successful fulfilment of a very onerous task.

The Science and Practice of Surgery. By W. H. C. ROMANIS, M.A., M.B., M.Ch. (Cantab.), F.R.C.S. (Eng.), F.R.S.E., Senior Surgeon in Charge of Out-patients and Teacher of Practical Surgery, St. Thomas's Hospital; and PHILIP H. MURCHNER, M.D., M.S. (Lond.), F.R.C.S. (Eng.), Surgeon in Charge of Out-patients, Teacher of Operative Surgery, and Demonstrator of Anatomy, St. Thomas's Hospital. Royal 8vo. Vol. I, General Surgery, pp. 795 + viii, with 666 illustrations; Vol. II, Regional Surgery, pp. 955 + vii. 1927. London: J. & A. Churchill. Per vol., 14s. net.

As one might expect from the school from which it comes, this is a good book—one had almost said a very good book. Criticisms, naturally destructive, must be those of minor points, for to a degree which is remarkable in a book written by more than one author, the general balance of space in proportion to the clinical importance of the subjects dealt with is unusually good. The make-up of the book is novel, for the first volume opens with a chapter on general surgical procedures; we trust that in future editions this will be enlarged—for instance, post-anæsthetic vomiting is dealt with in a few lines; if worth mentioning at all, it is surely worthy of discussion with some regard to the differential diagnosis of its causation and significance.

Page 41 contains two unnecessary figures showing how to invaginate the appendix stump, for there is a similar figure in Vol. II, but surely both are unnecessary

if the authors are acquainted with the much simpler and easier method of doing this by an N-stitch. In spite of a fairly wide experience of malignant pustules, one would never have expected that the three figures on page 87 are meant to suggest this disease; the fact that its normal course is toxæmic, and that when it becomes septicæmic in type the outlook is extremely grave, is not sufficiently insisted upon.

There are some chapters which are distinctly superior in level to those of the average surgical text-book. In this category we would place that on injury and diseases of the nerves in the first volume, and that on appendicitis in the second. Indications for operation on acute appendicitis are clearly and logically set out; if in parts the chapter shows a tendency to too frequent classification under headings and numbers, yet stress is laid upon matter of clinical importance, and one does not find long paragraphs devoted to subjects which one has never met with.

We trust that in the next edition, fortified by the success of the first, the authors will have courage to move in the direction towards which they occasionally show a timorous inclination. We suspect that they might have been more drastic had they been less afraid of the publishers, for one still finds whole pages of material dealing with matters which have been history for the last thirty-five years. Did they intend to write a book of practical value on surgery, or did they set out to write a history of surgery? If the former, why mention at all Pirogoff's amputation or all those others which are classified as of historic interest?

Again, much space is wasted on useless diagrams: four of the seven X-rays forming *Plate 4*, two of those forming *Plate 3*, and three of those in *Plate 1*, even to the trained eye convey little of importance. Outline drawings of X-rays would be infinitely clearer. Is not the American tendency to adopt a classification of fractures which conveys some indication as to their position, better than the adoption of such a term as 'chauffeur's fracture'—as a fact we believe that a chauffeur's fracture is usually suprazyloid—and does any surgeon nowadays use the splint depicted in *Fig. 191*?

It is to be hoped that the second edition will omit many of the figures which have no practical pathological interest or of rare diseases, such as *Figs. 125, 265, 273* in Vol. I; and *Figs. 50, 170, and 277* in Vol. II, while indicating subjects worthy of illustration, are so indistinct that they need to be redrawn.

Urinary Surgery: A Handbook for the General Practitioner. By WILLIAM KNOX IRVIN, M.D., F.R.C.S.E. Second edition, revised and enlarged. Crown 8vo. Pp. 271 + viii. 1927. London: Baillière, Tindall & Cox. 10s. 6d. net.

THE present volume is an attempt to give "in a concise and lucid form" the essential features of what is usually now known as surgical urology; indeed, in the first edition the work was christened *Surgical Urology*, but in his preface the author states that he has altered this, as "the original title was said to be ambiguous". We are not sure that the change is one for the better, as the name of the second edition seems to be even more ambiguous; we would suggest *The Surgery of the Genito-urinary Tract* as more exact though rather long.

After a description of the anatomy of the parts concerned and a chapter on the examination of the patient, the body of the work is divided into chapters on the principal symptoms likely to be met with in such diseases; this is a very practical method of dealing with the subject, but, unfortunately, it is almost impossible to avoid much repetition: the author thinks that this is an advantage, as it serves to emphasize important points. These are followed by a chapter on the enlarged prostate, and the last four chapters are devoted to operations.

There is a rather striking statement under the heading of cystoscopy: "The adoption of the lithotomy position for cystoscopy is of no advantage to the practised surgeon, involves needless delay and trouble, and causes quite unnecessary distress to many female patients". With the last part of this statement we think many surgeons will agree.

The book is well written, and contains a great amount of information in a very condensed form.

The Enlarged Prostate. By KENNETH M. WALKER, M.A., M.B., B.Ch., F.R.C.S., Jacksonian Prizeman and Hunterian Professor 1911, 1922, 1924, etc. Demy 8vo. Pp. 193 + xi, with 59 illustrations. 1926. London: Humphrey Milford. 12s. 6d. net.

IN this small and readable monograph will be found a very accurate and complete account of our knowledge of the enlarged prostate. One of the author's objects has been "to furnish those who are not experts in genito-urinary methods with a means of bringing up to date their knowledge of this subject"; we may add that those also who have devoted time and thought to these problems will find the book well worth reading.

We fancy that many of our readers will turn with most interest to the chapter on the pathology of this inexplicable enlargement; they will there find an excellent résumé of the various theories that have been proposed, and they will probably agree with Mr. Kenneth Walker when he states that "all that can be said with certainty is that every cause that has yet been suggested is either definitely wrong or else insufficient alone to explain the facts".

There are two chapters which will appeal to those surgeons who have struggled long and unsuccessfully with cases of the 'small fibrous type of prostate'; the one is entitled 'Prostatism without Enlargement', and is an attempt to elucidate the pathology of this condition; the other gives an account of the author's 'Perurethral Operation'; this consists of the destruction of the median bar by diathermy through a special instrument devised by him. In suitable cases he claims a low mortality, a high percentage of cures, and a smooth convalescence.

Tumeurs malignes des Os. By G. NOVÉ-JOSSERAND, Professeur de Clinique Chirurgie Infantile et d'Orthopédie à la Faculté de Médecine de Lyon; and L. TAVERNIER, Professeur agrégé à la Faculté de Médecine de Lyon, Chirurgien de l'Hôtel-Dieu. Medium 8vo. Pp. 430, with 48 plates in the text. 1927. Paris: Gaston Doin et Cie. Fr. 130.

THIS volume upon the malignant diseases of bone is one of the "Bibliothèque du Cancer" published in Paris under the direction of Professors H. Hartmann and L. Bérard. In its general lay-out plan it follows, in the main, some of the previous volumes of the series which have already been published.

In the chapter which is devoted to etiology some attention is paid to the traumatic origin of cancer, and also to the modern work by Gye and Barnard. This portion of the book, however, is comparatively scanty and is not of much importance. The chapter which is devoted to pathological anatomy is good. As regards the classification which is adopted in connection with the pathological anatomy of malignant tumours of bone, the authors divide them into the following groups: "(1) Les ostéosarcomes; (2) Les tumeurs à myélopaxes; (3) Les myélomes; (4) Les endothéliomes; (5) Les tumeurs secondaires". This chapter is perhaps the best portion of the volume. The illustrations, however, which are fairly numerous, have not been produced in a style which is equal to that of a good many modern French medical works. This remark refers especially to the reproductions of a rather numerous series of skiagrams. This inferiority in the reproduction of the skiagrams detracts to some extent from the value of the book.

The portion which is devoted to symptomatology is good, but again in this part the illustrations are distinctly poor, or at least the reproduction of the original illustrations is poor. The chapter on diagnosis and differential diagnosis is one of the good chapters in the book, but again the reproduction of the skiagrams is bad. The other illustrations, however, in this section are fairly good.

In the chapter devoted to treatment, operation is advocated as the method of choice. As to whether amputation should be carried out at the proximal portion of a long bone or disarticulation at the proximal joint, the authors seem to think, after a study of published cases and their own experience, that there is not much to choose. Resection of the affected portion of bone and replacement of the removed part by bone-grafts is considered at length. The authors point out that

it has been done by some English and other observers, but that the ultimate result is little affected by this particular form of operation, since a great majority of patients suffering from sarcoma of bone die from visceral growths which are present at the time of surgical operation and cannot be diagnosed in most cases, and, if diagnosed, cannot be removed.

Treatment by toxins, such as Coley's fluid, is discussed, and the conclusion come to from the authors' own experience is that they have not been able to get good results, and they think that the results obtained by Coley in America are much better than anyone has been able to obtain in the same kind of case on this side of the Atlantic.

As regards treatment by radiological methods, they think that radium has not given very good results, and they do not advocate its routine use. They think, however, that treatment by X rays is particularly useful in the round-celled sarcomata, since this variety of growth, in their experience, is very radio-sensitive. They found, however, that spindle-celled forms are not improved by this method of treatment.

The volume concludes with a very good bibliography, mainly Continental.

Exploration clinique et Diagnostic chirurgical. By FÉLIX LEJARS, Professeur de Clinique Chirurgie à la Faculté de Médecine de Paris. Second edition. Medium 8vo. Pp. 932, with 1094 illustrations. 1927. Paris: Masson et Cie. Stitched, Fr. 100; bound, Fr. 120.

THE author of *Urgent Surgery* has produced another original, voluminous, and probably popular volume. It is not so much a scientific treatise on surgery as one which deals with the art of surgery, and particularly how to examine a patient—how to examine a patient with the eye and the hand, how to palpate, how to percuss, how to measure and compare. Each region of the body is taken separately from the crown of the head downwards, and the technique of examination described for every sort of injury or diseased process. This 'craft' of surgery, if one may so describe it, is in danger of being lost in these days of specialism and ultra-scientific laboratory work, and Professor Lejars does a valuable service to the medical world in stressing the importance of this side of medicine. Most of the men who are plunged in their final examinations in medicine and surgery come to grief in the clinical section of the examination, and if the cause of failure is analysed, it is found nearly always to be faulty examination of the patient. In order to make a correct diagnosis of a patient, the physical signs must be sought for, and registered accurately. It is just as important to have a correct stance in examining a patient as it is to have a long ball at golf, and so it is worth while giving attention to the craft of surgery and educating our senses to the utmost.

This book, then, deserves well of the medical public, and if its lessons are all assimilated, many fewer mistakes in diagnosis will be made.

Diagnostic des principaux Cancers. By HENRI HARTMANN, with the collaboration of many medical men. Demy 8vo. Pp. 64, with 10 illustrations. 1927. Paris: Masson et Cie. Fr. 10.

THIS is a small book of 64 pages, which consists of reprints of a series of short articles which have already appeared in the *Presse Médicale* and now are brought together and published in book form. These short articles, which describe the early signs of cancer of different organs of the body, are designed to promote an earlier diagnosis of malignant disease, so that patients may be brought to the surgeon at an early stage in the disease.

Pathologie des Ménisques du Genou. By ALBERT MOUCHET, Chirurgien des Hôpitaux de Paris, and LOUIS TAVERNIER, Professeur agrégé à la Faculté de Médecine de Lyon. Medium 8vo. Pp. 100, with 25 illustrations. 1927. Paris: Masson et Cie. Fr. 18.

THIS monograph represents the report presented by the authors to the Surgical Congress in Paris held in October, 1926. It contains a clear and well-illustrated account of the chief lesions of the semilunar cartilages and of the cysts or pseudo-cysts to which they are liable. We have no criticism to offer in regard to the anatomical or pathological aspects of this work; but we confess to a feeling almost of consternation in reading the operative treatment proposed. The authors describe and figure, as the routine operation for lesions of the internal cartilage, one in which a transverse incision is made right round the inner side of the knee in a line with the joint. Through this the internal lateral ligament is divided. Such an incision does, of course, give an excellent view of the whole medial meniscus, but we have always considered that preservation of the internal lateral ligament is an essential necessity of any operation. Probably many of the poor results of meniscectomy are due to the fact that the lateral ligament has been torn or stretched by the original injury, and deliberately to cut this ligament appears to us a most dangerous and quite unnecessary procedure. It is true that the authors describe the careful suture of the lateral ligament as one of the concluding steps of their operation, but everyone is familiar with the fact that the effective suture of a ligament is a most doubtful and difficult undertaking.

Les Cancers du Sein. By PIERRE DELBET, Professeur de Clinique Chirurgicale à la Faculté de Médecine de Paris, Chirurgien des Hôpitaux; and MENDARO, Assistant étranger à la Clinique du Professeur Delbet. Royal 8vo. Pp. 343, with 100 illustrations and 4 coloured plates. 1927. Paris: Masson et Cie. Fr. 50.

THIS book is a record of personal histological and clinical work, mainly directed towards achieving such a classification of breast cancers as will enable a trustworthy prognosis to be given from the histological appearances of a particular case. It also deals with the origin and dissemination of breast cancer from a histologist's point of view, with symptomatology and diagnosis, operative methods, and results. There is a final chapter on non-operative therapy. The book is written in pellucid French which leaves no doubt as to the authors' meaning, and it is enlivened with graphic touches of description, seasoned by an occasional stroke of irony. It should certainly be studied by all who are interested in breast cancer. The authors present many original observations, and are always interesting even when they are not convincing. The illustrations are numerous and excellent, though personally we prefer photographs to histological drawings, however good.

Professor Delbet's main interest in the subject has been to discern a classification of breast cancers which will offer a secure foundation for prognosis. His work, therefore, is on the same lines as the recent work of Greenough, of Boston. As he truly says, "Une classification qui ne permet pas d'établir un pronostic est dépourvue d'intérêt". These words reveal the practical French spirit which guided Pasteur in all his researches, a spirit which desires to be helpful, and which finds in that desire, rather than in the cold joy of pure intellect, the true incentive to scientific work.

Delbet points out, as Bland-Sutton had done before him, that early and apparently favourable cases of breast cancer sometimes do badly, while advanced and ulcerated cases sometimes do well. He set himself to solve this problem. He gives reasons for thinking that the differences in malignancy do not depend upon the qualities of the stroma. He approached the problem by the re-examination of a large number of microscopic specimens of cases with known clinical histories, noting all the peculiarities of each specimen, hoping that these peculiarities might run parallel to those physiological peculiarities of the cancer cell which determine the clinical issue of the case. He claims only partial success in his quest. His classification is based partly on the morphology of the cancer cells, partly on the

presence or absence of invasion of the blood-vessels. Unfortunately, from the theoretical point of view, invasion of blood-vessels is seen, so he says, in 'benign' as well as in specially malignant cases. Contradictory characters, good and bad, may be present in the same case, and a large number of cases prove unclassifiable, as the author regretfully admits. He thus summarizes his conclusions:—

“Les épithéliomes en rognons à rosettes sont bénins, mais ils ne constituent pas une forme achevée de cancer. Je les considère comme une phase évolutive transitoire qui tends vers l'infiltration et la diffusion. Les épithéliomes à cellules claires sont des formes bénignes. Les épithéliomes mégacellulaires et les épithéliomes à cellules indépendantes sont des formes terribles. Voilà tout ce que j'ai pu tirer du rapprochement des caractères morphologiques et des caractères cliniques des cancers du sein. Je dois cependant ajouter que certaines formes d'infiltrations diffuses me paraissent comporter un pronostic grave. Ainsi lorsqu'il y a un grand nombre de plasmodes d'avantgarde pénétrant dans les interstices du tissu conjonctif, dans les nodules lymphocytaires, entre les vésicules adipeuses. Ainsi encore quand il est manifeste que les infiltrations des cellules cancéreuses se plient aux exigences du tissu conjonctif, ce qui indique que ces cellules ont perdu la cohérence et aussi l'adhérence.”

It will be noted that the author says nothing about the prognostic significance of the extensive areas of degeneration found in certain carcinomas. We are inclined to think that such areas are of good omen.

In discussing dissemination, Delbet has paid Sampson Handley the compliment of analysing his views at length. He fully admits the existence of permeation. He attributes to Handley the view that the blood-vessels play no part in dissemination, and that permeation is the only means of lymphatic spread. What Handley really maintained is that “the processes concerned in dissemination are mainly three in number: (a) permeation, (b) infiltration, (c) transealomic implantation. To these must be added as playing subsidiary parts: (d) lymphatic embolism, which leads only to gland deposits, and (e) blood-embolism, which is usually ineffective owing to the inability of the cancer-cells to colonize the blood-stream” (Choyce's *System of Surgery*, 1912). These views are still held by Handley. Delbet is a convinced advocate of dissemination by the blood-stream, and he describes a variety of cancer, *cancer lymphaphobique*, which, as its name shows, actually hates the lymphatic vessels!

M. Delbet permits himself a little sarcasm when discussing the process of perilymphatic fibrosis which was described in 1904 as destroying the permeated lymphatic and replacing it by a fibrous cord. He says:—

“Cliniquement il y a bien des cas où l'examen microscopique le plus attentif ne révèle aucune continuité entre le néoplasme primitif et les noyaux secondaires, mais ces cas n'embarrassent nullement Handley. Il déclare que la sclérose périlymphatique peut supprimer secondairement la continuité qui a primitivement existé. Cette sclérose périlymphatique, qui écrase doucement les cellules cancéreuses échappe à tout contrôle, et elle a une conséquence très importante, c'est qu'elle rend incontrôlable la théorie de Handley.”

He is too polite to add “Voilà son raison d'être”, nor does he refer to the photographs showing all the stages of the process which Handley's book contains, nor to the fact that there have been traced the various degrees of the process up to almost complete fibrosis along the length of the same lymphatic. We beg to assure M. Delbet that Handley's observations on this subject can be controlled and verified by any: “The subject is prepared to take sufficient trouble.”

Delbet's statement that cancer spreads in the plane of the deep fascia and not in that of the skin. Of the three cases examined, in the first he examined separately three little subcutaneous nodules. In the second he examined a fragment obtained by biopsy, and found a permeated lymphatic in the superficial subcutaneous tissue. In a third case, in which the opposite breast showed incipient invasion, he examined the skin at the edge of an area of peau d'orange, and found permeated lymphatics in the

dermis. In none of the cases did he examine the deep fascia, so far as his book shows. All the cases were inoperable.

Delbet states that in none of these inoperable cases would it have been possible to dissect up a flap so thin that it would not have contained cancer cells. He therefore concludes that Handley's advice to remove only a restricted circle of skin in operable cases is unsound—a very curious *non-sequitur*. In any such work the method adopted must be rigidly topographical and must investigate all the layers concerned. The application of microscopic methods on a microscopic scale and the accurate plotting of the cancerous foci are essential. Only thus can the relative spread of the disease in the skin and the fascia be determined.

Delbet criticizes the plate in which Handley demonstrated the spread of cancer in the fascial plane 25 mm. beyond the farthest point of infection of the skin. He prefers to transfer the contrast to one between the fascia and the deep subcutaneous fat. The latter layer showed an isolated focus within $5\frac{1}{2}$ mm. of the farthest infection of the deep fascia.

It would appear that, after the wide removal of skin which he practises, Delbet only secures coaptation of the edges by metal sutures, which are tightened with all the force of which the operator is capable. Surely this is the breast surgery of an earlier age. Moderate skin removal combined with freer fascial excision permits the flaps to be sutured with thin silk and almost without tension, and experience shows that after such an operation, local recurrence is very rare.

We make no apology for dealing at length with this question, which is of vital practical importance.

The most interesting section of the book is that dealing with dissemination by the blood-stream, a mode of invasion to which Delbet attaches great importance. He thinks it occurs mainly as a local process in the neighbourhood of the cancer by direct infiltration of the cells of the growth into capillaries and arteries. The occurrence of local nodules and their centrifugal spread can thus be accounted for by blood-capillary emboli. It is noteworthy that in 20 out of 21 cases classed as 'hæmophilie' cases there was invasion of the axillary glands, so that, as Delbet states, the 'hæmophilie' cancers are also 'lymphophilie'. To establish his case for blood-invasion, Delbet relies upon a striking series of figures showing cancer cells invading the arterial sheath, infiltrating the arterial wall, lying in a 'vein' and invading the blood-capillaries. All these figures are convincing except Fig. 54, where the structure of its wall shows that the supposed vein is a lymphatic vessel. They appear, however, to be all derived from one or two cases. The authors establish the *fact* of blood-invasion in breast cancer, but supply no weight of evidence as to its frequency or efficacy.

Die Chirurgie. A Manual of Surgery. Edited by Professor M. KIRSEHNER (Königsberg) and Professor O. NORDMANN (Berlin). Fasc. 13, Vol. IV, pp. 398, with 410 illustrations and 32 coloured plates. M. 27. Fasc. 14, Vol. VI, pp. 287, with 98 illustrations and 15 coloured plates. M. 18. Fasc. 15, Vol. VI, pp. 238, with 86 illustrations and 2 coloured plates. M. 13. 1927. Berlin and Vienna: Urban und Schwarzenberg.

FASCICULUS 13, which forms a part of the fourth volume of the work, deals with the surgery of the face and the upper and lower jaws, including the teeth, and is written by Professor Klapp, Dr. Franz Bauge, and Dr. Franz Ernst. Dr. Ernst gives a very full description of the developmental errors affecting the lips and hard palate. He lays great stress on the use of obturators in the treatment of palate defects, and describes an operation for complete cleft palate in which the soft tissues covering the hard palate are detached all round the margin of the alveolus, so that the new palate becomes shifted backwards as well and towards the mid-line. He makes no mention of the reversed flap operation, nor does he figure Brophy's method.

The sections dealing with plastic surgery of the face are very well illustrated by partly coloured diagrams which give the detail of many operative procedures; but one misses the full presentation of the tube-flap methods and those which utilize the skin of the chest for restoration of great facial defects. The articles on the

surgery of the jaws are of great value, especially in the description of various appliances by which defects after excision can be made good and deformity prevented. Several very ingenious operations for altering the size of the lower jaw are described and illustrated. The pathological anatomy of the jaw tumours is not given a full enough description, nor is it illustrated as the subject deserves.

The last chapter of this fasciculus is by Professor Beyer, of Berlin, and describes the surgery of the nose and its accessory sinuses. It is characterized by very excellent and clear anatomical illustrations, as well as a good account of the typical operations for the exposure and drainage of the accessory sinuses. The full-page coloured illustrations in this number are not of great artistic merit, but the figures in the text throughout leave nothing to be desired in respect of clearness and accuracy.

Fasciculus 14, which is part of Volume VI, is all by the pen of Professor Wehner, of Köln, and deals with the urinary bladder, prostate, and seminal vesicles. The description of the anatomy of these parts is very clear and well illustrated, but it would have simplified the subject if the anatomy of all three of these closely related regions had been described together, instead of in the two separate sections which introduce each part. The chapters dealing with clinical methods does not call for any special comment, except that the description and illustrations of modern cystoscopes are disproportionately short compared with those given of different types of catheters. Diverticula of the bladder are described in some detail, with many good illustrations. The distribution and character of the pictures call for some comment. No fewer than five figures are devoted to the operation of litholapaxy, and not one to excision of the whole or part of the bladder with transplantation of the ureters. The numerous coloured illustrations are beautifully reproduced, but the original drawings are often rather crude. The chapters dealing with the surgery of the prostate give a very complete account of the pathology and clinical aspects of the subject. The two-stage operation is strongly advocated in removal of the hypertrophied gland. In discussing the factors which decide whether a radical operation should be done, we do not think that the tests for renal efficiency are given sufficient prominence. Further, in dealing with the after-results we think that the common condition of retention of urine from closure of the vesical aperture is not sufficiently emphasized, whilst the comparatively rare possibility of recurrence of the prostatic tumour is fully discussed.

Fasciculus 15, a part of Volume VI, is by Dr. A. Weinart, of Magdeburg, and is concerned only with the spleen and the surgery of the so-called blood diseases. It deals very fully with questions of physiology, discussing the functions of the spleen and the problems of blood formation and destruction. The most valuable part of this section is the full discussion of the blood changes which occur after extirpation of the spleen, both in normal and diseased conditions. The principles and technique of blood transfusion are considered in detail, and the only criticism we can make about this chapter is that perhaps too many and too complicated methods are described. The blood diseases which are discussed are pernicious anæmia, hæmolytic jaundice, Banti's disease, Gaucher's disease, hæmophilia, lymphatic leucæmia, myelogenous leucæmia, and Hodgkin's disease. A summary of the essential nature of these diseases and their reaction to splenectomy or to ligature of the splenic artery is given after the general discussion, and this tabular presentation is most valuable.

Handatlas der Cystoskope. By Dr. OTTO KNEISE, Professor of Urology in the Halle-Wittenberg University. Second edition. Pp. 119, with 102 coloured illustrations. 1927. Leipzig: Georg Thieme; London: Henry Kimpton. 42s. net.

THE first edition of this work appeared in 1907; the explanation of the long interval which elapsed before the present edition was issued is to be found in the occurrence of the Great War and the subsequent Revolution, which was followed by such a rise in the cost of everything that the publication had to be delayed till prices became more nearly normal.

The atlas in question is, we believe, unique in that all the illustrations are by the author himself; in fact, Dr. Kneise goes so far as to assert that all such illustrations should be painted by the cystoscopist; we doubt, however, whether there are many cystoscopists who could paint as beautifully as Dr. Kneise. The work is not merely a cystoscopic atlas; there are 70 pages of letterpress devoted to a description of the cystoscope and the necessary technique, and to articles on the appearances of the normal bladder, of inflammations of the bladder, of hypertrophy of the prostate and trabeculated bladder, of bladder stones and foreign bodies, of vesical tumours and their therapy, of bladder fistulæ, diverticula, and ureteroceles, and to ureter catheterization and functional diagnosis.

The cystoscopic pictures are beautifully reproduced, and the letterpress is interesting and lucid. We do not think there is anything very new, but there are at least two subjects on which the author seems to us to be breaking new ground. (1) The first of these is a description of 'gangrenous dissecting cystitis', which Dr. Kneise, who was formerly a gynaecologist, had several opportunities of observing; he considers that this form of cystitis is nearly always due to the incarceration of the retroverted gravid uterus, to trauma during difficult labour, or to severe injuries to the bladder during the course of hysterectomy; we think that paraplegia should be added to that list of causes. He presents two most interesting pictures of this condition observed through the cystoscope, one during the acute stage and another very striking one showing the after-result. (2) The second is his description of the various fistulæ which may open into the bladder; amongst them are included some very good pictures of the cystoscopic appearances of implanted ureters; this subject is usually neglected in such atlases, and the author's remarks thereon and the accompanying pictures are well worth study.

His last chapter, on the study of the functional efficiency of the kidney, is rather scanty and not, we consider, up to the level of the rest of the book; pyelography is omitted, and the remarks on the congenital abnormalities of the urinary tract are limited to the mention of the occurrence of duplication of the ureters.

We sincerely congratulate Dr. Otto Kneise on the production, and after studying it we are left in doubt whether most to admire his skill as an artist, his scientific attainments, or his wonderful capacity for hard work.

Intracranial Tumours and some Errors in their Diagnosis. By Sir JAMES PURVES-STEWART, K.C.M.G., C.B., M.D. (Edin.), F.R.C.P., Senior Physician to the Westminster Hospital, etc. Demy 8vo. Pp. 206 + xii, illustrated. 1927. London: Humphrey Milford. 12s. 6d. net.

THE author has produced a readable and practical volume based entirely upon his own personal experience of some 250 cases of intracranial tumour. The lessons which are to be learned from a study of this material are clearly demonstrated by admirably concise clinical notes and by well-selected illustrations. The chapter on errors in diagnosis is most valuable. The book contains but little direct reference to the surgery of the subject, but it should well repay careful study by all those who undertake the operative treatment of intracranial tumours.

Tropical Surgery and Surgical Pathology. By KARUNA K. CHATTERJI, F.R.C.S.I.; Major, I.T.F. Medical Corps; Surgeon, Medical College Hospitals, Calcutta. With a Foreword by Major-General Sir R. HAVELOCK CHARLES, G.C.V.O., K.C.S.I., M.D., etc. Demy 8vo. Pp. 244, with 91 plates, 20 in colour, and 5 charts. 1927. London: John Bale, Sons & Danielsson. 16s. net.

THIS is a book that will be of value chiefly to the surgeon who practises, and the student who learns, in the Tropics, but it can be recommended also for reference to the European surgeon, who finds little enough in the standard text-books on surgery to help him with the occasional instances of tropical surgery that cross his path.

The greater part of the volume is devoted to an exhaustive description of the various forms of amœbiasis and filariasis. The tropical granulomata also receive adequate treatment, but the sections on abdominal surgery in the Tropics and neoplasms in the Tropics are somewhat too sketchy to be satisfying. The author has surmounted the difficulty of writing a text-book in a foreign language with remarkable success, and the work is on the whole well arranged, though a tendency to redundant statements might with advantage be eliminated in a later edition. The book is profusely illustrated, and most of the illustrations are clear.

Recent Advances in Hæmatology. By A. PERRY, M.D., Ch.B. (Birm.), M.R.C.P. (Lond.), Research Pathologist, Cancer Hospital, London. Crown 8vo. Pp. 276 + viii, with 4 coloured plates and 18 text figures. (Recent Advances Series.) 1927. London: J. & A. Churchill. 12s. 6d. net.

This long-wanted book finds us eagerly expectant, but—perhaps because we hoped for so much more—leaves us very unsatisfied. The writer deliberately confines himself to blood cytology, thus rendering necessary another volume in which shall be collected the recent work on other aspects of hæmatology. Then, again, this volume differs from others in the series in that but little space is afforded to the practical aspects of the subject, and that the proportion of debatable theory is so high. A work of this kind should, we feel, be a collection of those recent advances which have met with a sufficiently wide acceptance by hæmatologists; and such subjects as the writer's own views on the reticulo-endothelial system, and the site of formation of megakaryoblasts, should find expression for the moment under some other cover.

We are inclined to agree with the writer in his renunciation of the oxydase reaction as not being positive in the earliest myeloblast; but the work of Price-Jones on the diameter of the red cells, and of Ledingham on platelets, might well be discussed fully. The coloured illustrations are exceedingly good—among the best we have ever seen—but we are not convinced that the writer's method of making blood films is the best, and we are very envious of the facility with which he appears able to distinguish myeloblasts from lymphoblasts.

Although we are not prepared to agree with the writer on quite a number of points, there is much in this book which makes it well worth reading. We feel, however, that it should have appeared under another guise, with a different title. A very good and helpful bibliography is appended.

Orthopædic Surgery. By W. A. COCHRANE, M.B., Ch.B., F.R.C.S.E., Assistant Surgeon, Royal Infirmary, Edinburgh, etc. Demy 8vo. Pp. 528 + xxiii, illustrated. 1926. Edinburgh: K. & S. Livingstone. 21s. net.

MR. COCHRANE in the first part of his book approaches the subject of orthopædic surgery from a standpoint that is new to this country. He is anxious "that the student should banish the idea that he is concerned only with an aggregation of local problems of deformity, important as they are, and will substitute a conception on the broad basis of anatomy with reference to the statics and mechanics of the body as a whole. It is only through these spectacles that disabilities of the locomotory apparatus of the body can be viewed intelligently and linked up with knowledge of pathology, medicine and surgery."

A lengthy consideration is given to the different human types, differentiated by their anatomical structure and postural habits, to the work of Goldthwait, Bean, and others, and to the liability of the different types to particular diseases. Further, there is a good description of the work of Sherrington and Hunter on muscle tone and the mechanism of the maintenance of posture, so that finally this side of orthopædies—the habitual posture of the patient and the activity of the body—is brought in as a factor in effecting prevention and cure in many branches of medicine and

surgery. It is perhaps unfortunate that the nomenclature that has been adopted in describing human types—for example, the “splanchnoptotic, congenital visceroptotic, or carnivorous” type—makes reading of this subject somewhat difficult. This, together with the fact that all such work is in the early and not altogether scientific stage, is a little apt to make the general reader pass over the subject with the idea that there is really very little in it. It is, however, a side of medicine which will very well repay further study. Two examples of its importance may be quoted. Orthostatic albuminuria has been shown to occur in young people in whom a particular postural type is present, and such albuminuria has actually been brought on by artificially inducing a posture of lordosis. Rieser has suggested that in this position the left renal vein may be compressed in certain people. Codman considers that ulcers of the stomach and duodenum may be due to bad posture, and others have shown that a chronic duodenal ileus may arise from compression of the root of the mesentery, a possible result of defective posture.

The latter part of this section of the book is given up to physical education in relation to medicine. Goldthwait's system of exercises is described, and although this has no advantages over the Swedish system generally adopted in this country, it has the great merit of simplicity.

The second portion of the volume deals with orthopædic surgery on more ordinary lines; it is systematic and thorough. As an example, the section on deformities of the foot and ankle may be taken, where a description of the anatomy and function is followed by simple mechanical disabilities—a more important section than that on the severer deformities, because the disabilities are so very much more common. The commoner injuries in the shape of sprains and ordinary types of fractures are included, and all details of the author's own methods of treatment are described at sufficient length to enable them to be imitated, but without undue detail of operative procedures.

The book is very well and clearly illustrated, and is both suitable for the student and practitioner and useful for the orthopædic surgeon.

L'Angine de Poitrine et l'Angine abdominale. By D. DANIELOPOLU, Professor of Clinical Medicine in the Faculty of Medicine at Bucarest, etc. 4to. Pp. 443 + viii, with 159 illustrations (some in colour). 1927. Paris: Masson et Cie. Fr. 140.

Thus comprehensive work in French makes available the labours of Professor Danicopolu in the symptomatology, etiology, pathology, and treatment—especially surgical—of angina. It is a stupendous volume—complete, erudite, and exhaustive—and the argument is unfolded in epic fashion. The notions in it are well known by the author's former publications, but this book represents his *magnum opus* and finished views. As a physician the Professor would not have had the full approval of Allbutt or of MacKenzie for this volume, nor is Wenckeback in full accord; and the purely clinical side of the surgical treatment has already been rather unkindly criticized in England by Lewis. But as a physiologist and clinical pathologist directing a surgical technique the Professor is a pioneer, and his erudition places him far out of the reach of criticism.

There are two notable contributions to the science of medicine. The first is an emphatic insistence on the unity of the basic pathology in the various syndromes known to English readers as angina pectoris, false angina, pseudo-angina, and abdominal angina. This basic pathology is held to be an ischæmia of contractile tissue brought about as a rule by an obstructive arterial lesion, and the consequent accumulation of toxic products in the tissue with harmful stimulation of sensory nerve-endings. Pure and organic angina is mainly expounded in the book, and the sensory nerve-endings in the heart muscle, their path in the cardio-aortic nerves, and the places where they are vulnerable to surgical treatment are clearly charted. The second contribution is a consideration of the ‘pressor reflex’ conveyed in these nerves. Along with a description of the pressor reflex there is naturally an account of the anatomy and pathology of the nerves concerned in the agony. These latter

nerves are happily closely related anatomically with the nerves bearing the pressor reflex. In essence Danielopolu's conception of angina pectoris is :—

1. For some reason a disturbance of balance between the work of the heart and its vascular nutrition occurs—whence

2. Toxic bodies accumulate in the heart muscle, and these

3. Stimulate the endings of the cardio-aortic nerves. By this

4. Two groups of reflexes are launched. The one is the pressor reflex by which the blood-pressure is heightened and the force of the heart-beat augmented, thus setting up a vicious circle in a heart already burdened. The second is a discharge of sensibility along associated nerves, whereby the anguish and agony of the anginal attack are represented and brought into consciousness in the clinical syndrome so well known.

5. Both these nerve-paths can be interrupted by section of the *cervical sympathetic*; section of *certain fibres of the cervical vagus*; section of the *intrathoracic branches of the cervical vagus*; section of the *vertebral nerve*; section of *communicating branches* uniting the inferior cervical ganglion and 1st thoracic nerves with the 6th, 7th, and 8th cervical nerves and 1st dorsal nerves.

To English and American readers—of whom there will be many—it will appear strange that such a book should be so ill-bound and that it should contain so many literal errors, especially in the large bibliography. The chapter on etiology is intensely disappointing, and is indeed little more than a blank '*ignoramus*'. Many of the diagrams take hours to unravel, but the complexity of the subject is responsible for this. The photographs are magnificent. The whole volume is fairly easy to read if one puts one's elbows on the table: not otherwise.

This great work is certain to have an immense vogue in Western Europe and America, but the classical views of Allbutt and Mackenzie, the *tour de force* whereby Wenckebach addressed the Royal College of Physicians of London in 1924, the writings of Leriche, the work of Coffey and Brown in America, and the researches of Langley and Jounesco, must be consulted by those who embark on the procedures advocated.

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EPOCH-MAKING BOOKS IN BRITISH SURGERY.

By SIR D'ARCY POWER, K.B.E., LONDON.

III.

A PROVED PRACTISE FOR ALL YOUNG CHIRURGIANS BY WILLIAM CLOWES MAISTER IN CHIRURGERY.

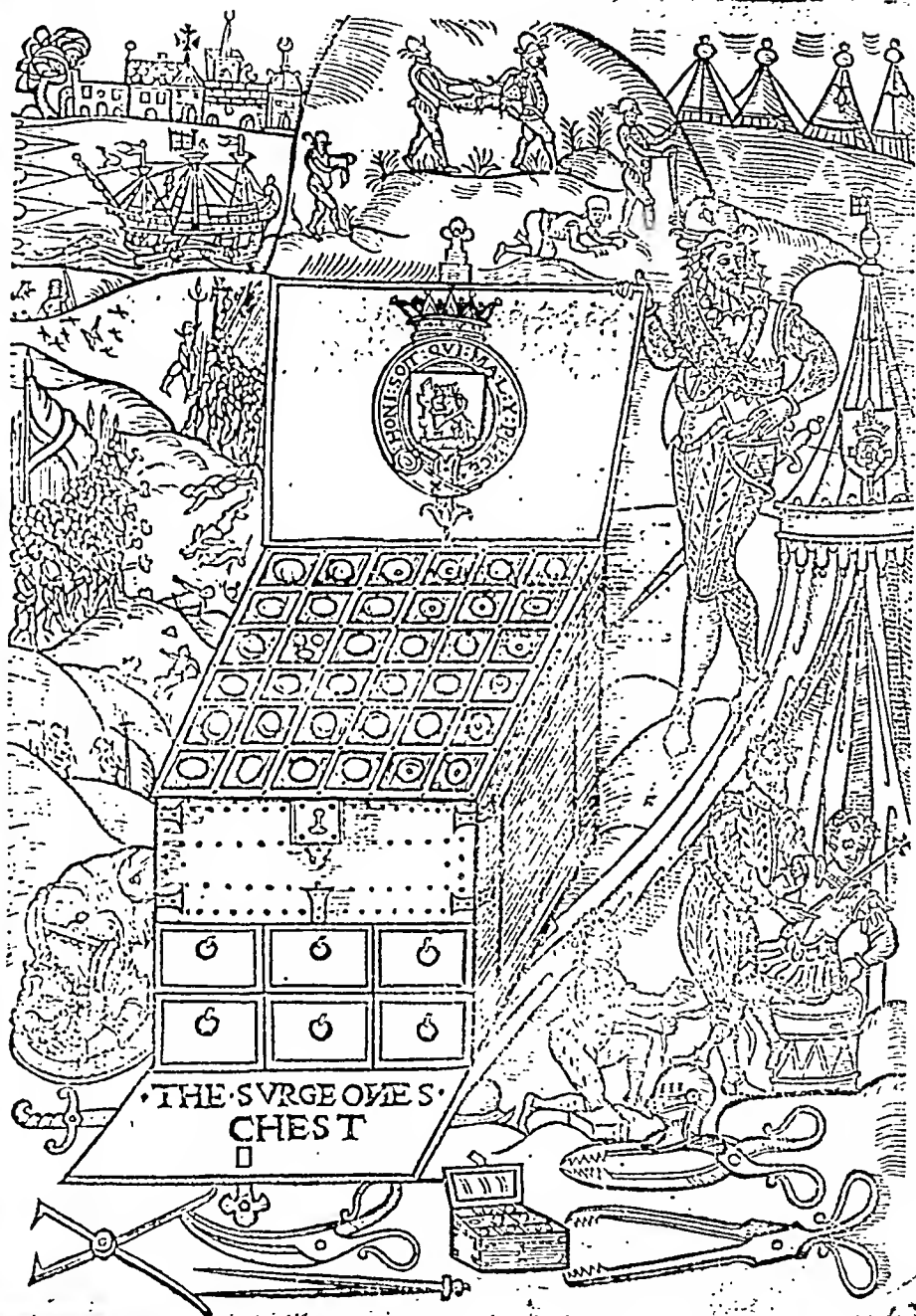
WILLIAM CLOWES the elder, for he had a son who was Serjeant Surgeon to King Charles I, was one of the most prolific surgical writers of his day. He was on good terms with his fellow-surgeons because he was honest in all his dealings, but he hated and was hated by the numerous quacks and unlicensed practitioners who abounded in London in the middle of the sixteenth century, and he made common cause with Gale, Hall, and Read to expose their misdeeds and to raise surgery to the dignity of a profession. The first act of the United Barber-Surgeons Company was to improve the surgical education of their apprentices and members. Examinations were instituted, Gale and Clowes made the examinations a reality and tried to improve the standard by writing treatises which correspond to our modern text-books. Both wrote in English, but the method adopted by Clowes was wholly different from that used by Gale. Clowes told in detail the particulars of cases which he had himself seen, and then set out the treatment he had adopted. He was a good surgeon, trained in the wars like Gale, but he had his limitations, at any rate according to modern views. He was too fond of ointments and plasters, and was especially proud of an oil of whelps (*Oleum catulorum*) which he had invented, though he does not explain why puppy dogs' fat was better than that of lard or suet. "The Proved Practice" was published in 1588, and it may therefore be looked upon as the third text-book of surgery published in English of which we have at present any certain knowledge—Arderne's works being the first; Gale's being the second. The treatise deals chiefly with gunshot wounds and similar injuries, but much incidental matter is introduced, and it is well worth reading for a picture of life in the times when it was written. Chapter 8 gives an account of the amputation of a "mortified and corrupt leg or arm" in the following words:—

"If it so fall out, or happen, that a leg is to be cut off beneath the knee,

let it be distant from the joint four inches, and three inches above the knee; and so likewise in the arm as occasion is offered. These things being observed and noted, then through the assistance of Almighty God, you shall luckily establish this work by your good industry and diligence. But you must be very circumspect and careful of all things which concern the methodical perfection of this work, that is, you shall have a great regard to the state of his body as also for evacuation and dieting. And after his body is prepared and purged, then the same morning you do attempt to cut off the member, be it leg or arm, let him have two hours before some good comfortable caudle or other broth, according unto the discretion of the learned Physician or Chirurgeon only to corroborate and strengthen his stomach. And in anywise omit not but that he have ministered unto him some good exhortation by the Minister or Preacher. And you shall advertise the friends of the patient that the work you go about is great and not without danger of death for that many accidents or sytomics [*perils*, says Arderne's commentator two hundred years earlier using the same word] do run and flock together unto such great wounds, which desperate evils in such causes will many times admit no cure. All which being considered, then ordain the night before some good defensive and let it be applied two or three times about the member.

"All which being well considered you shall have in readiness a good strong form and a steady, and set the patient at the very end of it; then shall there hestride the form behind him a man that is able to hold him fast by both his arms, which done, if the leg be to be taken off beneath the knee, let there be also another strong man appointed to bestride the leg that is to be taken off and he must hold fast the member above the place where the incision is to be made, very steadily without shaking, and he that doth so hold should have a large hand and a good grip, whose hand may the better stay the bleeding; but in some bodies it will not be amiss to admit bleeding, specially in such bodies as are of hot complexions and do abound in blood. And I have known through the skillfulness of the holder not much above four ounces of blood lost at a time. But in weak bodies it may not be suffered to lose much blood, for blood is said to be the treasure of life, for which cause a good holder is not to be spared. In like manner there must be another skillful man that hath good experience and knowledge to hold the leg below, for the member must not be held too high for staying and choking of the saw, neither must he hold down his hand too low for fear of fracturing the bones in the time it is a sawing off, and he that doth cut off the member must be sure to have a sharp saw, a very good catlin and an incision knife, and then boldly with a steady and quick hand cut the flesh round about to the bones without staying, being sure that the Periosteum or Panicle that covereth the bones be also incised & cut with the nerve that runneth between the two bones of the leg which shall be done with your incision knife. All this being orderly performed, then set your saw as near the sound flesh as easily you may not touching it, and with a light hand speedily saw it off. Then take of (a restrictive) powder as much as will serve your turn and mix with the said powder *Pilorum leporis torrefact.* & *ovorum albumin* ana quantum sufficit and let the Hare hairs, I say, be cut as fine as possible may be, so much as will bring it all to a reasonable thickness, and when the

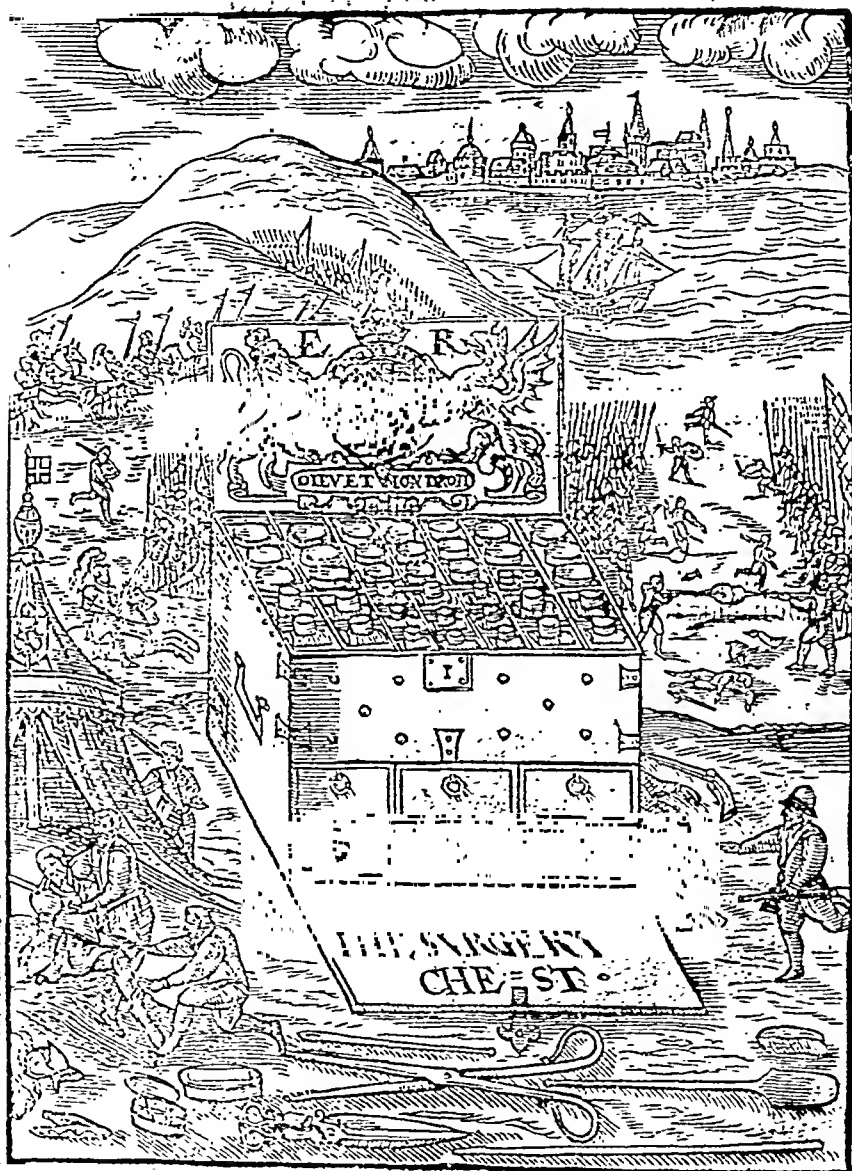
powder is thus prepared, before you cut off the member, let there be in like manner made for the purpose three or four small bolsters or buttons fashioned in the top or upper part like a Dove's egg or as a sugar-loaf button flat in the bottom to the compass of a French Crown, and round upwards as aforesaid and these you shall make of fine Tow according to art wrought up in water and vinegar, whereupon you shall supply some part of the restrictive. And when the holder of the member above doth partly release the fast holding of his hand by little and little by which means you may the better perceive & see the mouths of the veins that are incised and cut, you shall place the round ends of these three or four small buttons and upon them presently, without tarrying, place a round thick bed of tow made up in water and vinegar so that it be fit, as near as you can guess it, to the compass of the stump or member that is taken off and thereon spread of the restrictive and upon that you shall lay another broader bed of tow made up as aforesaid, so large that it may compass the member over . . . and you shall tie on the large bed of tow, being cut first with a pair of Scissors in four parts thereof, one cut right over against another, an inch long and somewhat more, that the said bed may be bound to with the more ease. And you shall tie the large bed to, as I said, with a ligature, which they call a chokeband, doubled two or three times, being flat and fully an inch broad and a yard long, and you shall place upon these a double large bed of soft linen cloth and then with a strong roller of four inches broad and three or four yards long let it be artificially rolled and where as the blood beginneth to shew through all, in that place you shall specially lay a good compressor or thick bolster made of tow wrought up in water and vinegar the thickness almost of a man's hand and thin towards the edges and in compass of a Philip's dollar more or less, as you suppose the greatness of the flux to be, and couch them close to in as many places as the blood doth show itself and thus, with three or four rollers and as many soft linen beds some single and some double with sufficient number of bolsters, some great and some small, you shall artificially stay the flux of blood; which order and way did yet never fail me, nor any other that have used the same according unto the order here prescribed. Some also do use to draw over the great bed of tow a wet Ox bladder and pulleth it close up over the same, the which they tie fast to with the aforesaid ligature or chokeband. All which being orderly done then you shall easily as possible may be, carry the patient to his bed, having a pillow made ready to rest the member on. Thus let him lie with as much quietness as may be, keeping a convenient diet; then the third or fourth day you shall have in readiness stupes of white wine with a recent roller, &c." The parts may be burnt with a bright cauterizing iron which, says Clowes, "is most excellent but that it is offensive to the eye and bringeth the patient to great sorrow and dread of the burning and smart." Master Gale's powder may be used, "which powder of his was a worthy invention and better pleased the patients than the burning irons which were, I say, very offensive unto the eye and yet the powder wrought with extreme pain and made a very great eschar & by that means the bones afterwards hath been cut off new again, as I have seen many times within the Hospital of St. Bartholomew's and so did make a very long work or ever they were cured." He invented, therefore,



THE SURGEON'S CHEST FROM THE 1588 EDITION OF CLOWES' SURGERY.

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Observations for



THE SURGEON'S CHEST FROM THE 1596 EDITION OF CLOWES' SURGERY.

a powder which had not these disadvantages, "the which I did put first in practice in the hospital of St. Bartholomew's, as it is well known unto some of the Surgions that then served there, and yet live within this City of London, who were present with me when I first put it in practice, at which time there was taken off in one morning seven legs and arms and so, by God's assistance, we stayed all their fluxes of blood without any pain unto them but only in the compression and close rolling and tenderness of the wound excepted. Not many days after the worshipful Maisters of the said Hospital requested me with the rest of the Surgians to go to Highgate to take off a maid's leg, which they had seen in the visitation of those poor houses. The said leg was so grievously corrupted that we were driven upon necessity to cut it off above the knee, which we did perform by this order here above prescribed, and we stayed the flux and lost not much above four ounces of blood and so cured her after within a very short time."

Clowes sometimes ventured on more serious operations. For instance, "There did come unto me to be cured a Gunner of a ship which was dangerously wounded in the lower region of his belly so that a great part of the Zirbus or Omentum did come out of the wound and also some of the intestines proffered themselves to come forth likewise; but the patient did keep all very close and well till he came unto me. Then I caused him to lie down on a bed upon his back and, after search made, I found the guts safe and not touched of the weapon; then with a strong doubled thread I did tie fast the Zirbus, as close unto the wound as possibly well I might, and then a finger breadth or thereabouts I did cut off that part of the Zirb that hanged out of the wound, and so I canterised it with a hot iron almost to the knot. All this being done I put again into the body that part of the Zirb which I had fast tied and I left the piece of the thread hanging out of the wound, which within four or five days after nature did cast forth. The thread, as I say, being fast tied, then presently I did take a needle with a double strong silk thread well waxed, wherewith I did thrust through both Mirach [the abdominal wall] and Siphac [the peritoneum] on the right side of the wound, but on the left side of the wound I did put the needle but through Mirach only. . . . Thus with good bolstering and rolling he rested till the second day. Ye shall understand that immediately after he did complain of the grudging of an Ague and being therewith somewhat distempered, presently there was opened a vein and forthwith a gentle mollifying Clyster also. Then, shortly after his bleeding and purging, he mended again and by this means his fever was prevented. Thus in foreshowing of the evils that happened in this cure you may the easilier shun the dangers in others." Also in 1580 there was one, William Monch, "a serving man who received a wound in his belly and the Zirb issued out of the wound so broad in compass that it did very easily cover a great square trencher, which was cured likewise with the order and remedies afore rehearsed. Moreover in Anno 1586 a little girl of the age of ten or twelve years was also wounded in the belly with a knife that she carried in her hand, so that the Zirb did come forth of the wound the compass of a man's hand, she being then in the country seven miles from London. I did not use any canteries unto this girl neither yet unto the serving man. The reason partly was for that neither the patients nor their friends

would willingly hear of the hot irons although it were said to be a safe and sure way. Neither did I find any discommodity for not using them, which girl was afterwards brought to London whom I likewise did cure in a very short time; for the which the name of God be praised."

There is also the interesting "cure of a man which received a notable wound in his head with great fracture of the skull and did moreover fracture the bone of the thigh called *Os Femoris*, by a fall out of a gallery in the Bear Garden, at that time when the Bear Garden did fall down and did kill and hurt many." Clowes operated immediately, shaved the head, put his finger into the wound, found a fracture, enlarged the wound and could do no more because of the bleeding. He therefore plugged the wound and put on a bandage. Then "I caused them to hang all his chamber round about with coverlets and other hangings and made it very dark and without any light or air but only by a candle because in this case air is very hurtful. Then at the second dressing, after I had opened the wound and taken away all things wherewith the wound was filled for the restraining of the blood I caused two strong men steadfastly to stay his head with their hands; and having stopped his ears with wool then I did set on a trepan and so pierced the skull through both the tables in two places and then with an instrument called a *Levatory*, I raised up the depressed bone with great care and diligence for fear of procuring further accidents, which being done presently his speech amended. And upon *Dura mater* I found a good quantity of congealed blood which presently I removed for fear of pain and inflammation. After the blood with speed was taken away there was also very apparent to be seen a certain blackness upon *Dura mater* for the which cause I did put between *Dura mater* and the skull a fine piece of *Lawn* dipped in *Melle Rosarum*. And there was good flesh brought upon *Dura mater* and the fractured bones being so loosed and borne up and in the place of these bones Nature supplied and ordained a good and perfect callus. And thus he was shortly after well and perfectly cured and made whole of the said wound of his head."

There is also an excellent account of a stout fellow who received a sword thrust through his sternum, the point of the sword coming out at his back. Clowes told those that were present that he greatly feared there was no way of cure, "and so in truth I refused to dress him supposing that he would die under my hand. Then the wounded man desired me as ever I loved a man that I would dress him and take him in cure; for (said he) my heart is good although my wound be great." Clowes cured him, and five years after he had been made whole "he did come to London partly to see me and to give thanks and did show the place that was wounded both where the sword went in and where it did come forth."

The illustration of "The Surgeon's Chest" is reproduced from the 1588 edition. It appears again in the 1591 edition, but in that of 1596 it has been re-engraved, reversed, and materially altered. The Arms of the Earl of Warwick are replaced by the Royal Arms with E. R. on each side. In place of the Stretcher panel there is a view of London showing Old St. Paul's and a ship sailing on the Thames. The bottles in the Chest have been provided with stoppers, and the smaller chest standing by its side has been removed.

CHOLECYSTOGRAPHY: TOXIC EFFECTS OF THE DYES.**A CLINICAL AND EXPERIMENTAL STUDY.***

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A VERY striking advance in the radio-diagnostic investigation of cholecystic disease was made by Evarts Graham when he introduced sodium tetraiodo-phenolphthalein for that purpose. This new method has obtained wide popularity and has stimulated a closer interest in the problems of biliary diseases. Most writers on the subject refer to the not infrequent toxic manifestations that have been observed after the administration of the agent. These toxic symptoms may be local or systemic, and have varied widely in form and degree. Common phenomena, in our experience, are varying degrees of upper abdominal pain, nausea, vomiting, and diarrhœa, often attended by a rise of temperature. In those cases showing reaction we have been impressed by the frequency of pain or discomfort in the hepatic region. As far as we are aware, only one fatality has been reported from the administration of the drug, which was given in a dosage of 5.5 gm. (Huddy).¹

The object of our communication is to record some toxic effects of the drug which have not hitherto been observed, and have, in our opinion, an important practical significance; and also to present our experimental investigations of the drug, especially in so far as they bear relation to our clinical experiences.

The first clinical case was one of acute hæmorrhagic pancreatitis, which followed immediately after an intravenous injection; the second was one of jaundice following administration of the drug; the third case recorded was one in which death occurred in a young jaundiced patient within thirty hours of the oral administration of the sodium salt.

In the experimental study, which was carried out upon cats and rabbits, we have endeavoured to reproduce, as far as possible, conditions obtaining in the human subject. Particular attention was devoted to the following considerations: (1) The action of the drug on the pancreas; (2) The action of the drug upon the liver and the kidney in experimental common-duct obstruction; (3) The mode and rate of excretion of the drug in conditions of biliary obstruction.

* From the Departments of Clinical Surgery and Experimental Surgery, University of Edinburgh.

CLINICAL RECORD.

Case 1.—Robust miner, age 40, admitted to hospital on account of dyspepsia of six years' duration.

HISTORY.—The man's symptoms had at first been of a rather mild character and took the form of a sense of tightness or fullness in the epigastrium soon after meals. Fatty foods disagreed with him, and a full meal of any sort resulted in troublesome flatulence. For two years before admission the symptoms had been more distressing, and gnawing pain below the right costal margin was frequently experienced. Only on two occasions had the pain been very severe; it had then assumed a stabbing character and radiated through to the back and to the right shoulder-joint, and was attended by bilious vomiting. He had never been jaundiced, but he had noticed that his complexion had been rather sallow during the last year.

ON ADMISSION.—The man was of average height and weighed about 12½ stones. His appearance was that of good health, although his complexion was rather muddy. Examination of the abdomen revealed the presence of deep tenderness and muscular resistance when firm pressure was exerted in the right subcostal area.

The history and clinical examination were suggestive of gall-stone disease; and as a means of confirming this diagnosis the patient was prepared for cholecystography; 5.5 grm. of freshly prepared sodium tetraiodophenolphthalein in 40 c.c. of distilled water were given intravenously, with the usual precautions, at 8.30 in the evening. A feeling of nausea followed the injection. Three and a half hours after the administration the patient began to complain of severe pain in the upper abdomen and in the loins; he spent a restless, uncomfortable night; and on three occasions he vomited light-brown material.

In the morning the temperature was 100°, and the pulse-rate was 90. Pain was more severe and was continuous. Vomiting of a little dark material was repeated at intervals during the day. The vomit was never bilious in character. The patient had become decidedly ill and was considerably shocked, with a rapid pulse; and on examination the abdomen was found to be acutely tender and rigid in its upper part.

By the following day the man was gravely ill; pain was intense and retching was persistent; the abdomen showed considerable distention; the skin was clammy and the lips were a little blue.

OPERATION.—A tentative diagnosis of acute intestinal obstruction was made and the abdomen was opened. From the peritoneal cavity about three pints of maroon-coloured thick fluid escaped; and scattered spots of fat necrosis were noticed on the greater omentum. The small intestine was distended with gas. The pancreas, though only moderately enlarged, was converted into a hemorrhagic mass. The gall-bladder was twice the normal size and was very thick-walled; it was packed tightly with small faceted stones. The common bile-duct contained several small calculi. It was not determined if a stone was impacted in the biliary ampulla.

As the man's condition became very critical, his return to bed was hastened, a drainage tube being placed in the region of the pancreas. Death occurred the same day. Permission to make a post-mortem examination was not obtained.

COMMENT.—The weight of the drug administered was 5.5 grm., which was the customary dose employed at the period when the patient was in hospital. It must be recognized that this dosage was in excess of that originally recommended by Evarts Graham.

As this acute abdominal crisis appeared within three and a half hours of the giving of the drug, our suspicions were strong that the drug had been responsible, in some way, for exciting the onset of the crisis, especially as the patient had been in good health immediately before its administration.

Case 2.—Woman, age 50, admitted for pains in her joints and indigestion of three years' standing.

HISTORY.—The patient had noticed that her appetite was failing and that many of the common articles of diet, such as potatoes and thick soups, disagreed with her.

After a heavy meal she had pain in the upper abdomen, accompanied by flatulence which produced a sensation of choking. For nine months she had had occasional attacks of sharp pain in the right hypochondrium soon after food, attended by nausea and headache, and occasional shivering attacks.

ON ADMISSION.—The patient was of sallow complexion and of flabby build; weight $10\frac{1}{2}$ stones. Her temperature was subnormal. Examination of the abdomen showed the presence of slight tenderness on deep pressure below the right costal margin at the outer border of the right rectus.

The patient was made ready for cholecystography as the symptoms suggested that a lesion of the gall-bladder was responsible for her dyspepsia; 3.5 gm. of sodium tetraiodophenolphthalein in 50 c.c. of water were given intravenously at 8.30 in the evening. There was no immediate reaction after the injection. In the early part of the night the patient complained of headache, and shivered once or twice. At 2 a.m. the headache was more severe and she felt very sick. Next day it was noticed that she was slightly jaundiced, this being most evident in the sclera. The temperature had risen to 99° ; and pain and increased tenderness were present in the right subcostal region. Jaundice persisted for two days and gradually became less evident.

In the radiograms the gall-bladder was not outlined.

OPERATION.—The gall-bladder was of normal size; its walls were thickened and it contained two large stones and a small one. One of the large calculi was a pure cholesterol stone and was gripped securely at the neck of the gall-bladder. Bile was absent from the gall-bladder, its place being taken by a small quantity of clear mucoid fluid. There was no stone present in the common bile-duct. The pancreas was enlarged and was extremely tough and fibroid in consistence. Cholecystectomy was performed; recovery was uneventful.

COMMENT.—The occurrence of jaundice following an injection of sodium tetraiodophenolphthalein has not been noted before. The cause in this case is not clear. Nulhall² mentions a case in his experience in which existing jaundice was increased by the exhibition of the drug intravenously.

Case 3.—Unmarried girl, age 20, of strong physique, admitted on account of attacks of abdominal pain and jaundice.

HISTORY.—The patient was strong and healthy until three months before coming to hospital. During that time she had had repeated attacks of fairly severe pain in the right upper quadrant of the abdomen and in the right iliac fossa. The attacks of pain seemed to come on after severe exertion, and on an average she had two in a week; she felt quite well in the intervals, and her appetite remained good. On three occasions the attacks of pain were attended by vomiting; and for some time before admission she had been troubled with flatulence after meals. After two of the painful attacks she had been slightly jaundiced, but the jaundice quickly passed away. The attack which culminated in her admission to hospital was attended by deeper jaundice, which had been present for six days before she came under observation.

ON ADMISSION.—Except for the moderately deep jaundice the patient looked strong and well. Temperature 99° ; pulse-rate 85. The stools were pale and bulky, and the urine was dark from its bile content. On abdominal examination the patient was found to have tenderness over the upper part of the right rectus muscle, and a slight amount of muscular rigidity was present there.

The patient, though young, was thought to be suffering from gall-stones, and preparation was made for cholecystography; 10 capsules, each containing $\frac{1}{2}$ gm. of sodium tetraiodophenolphthalein, were given by the mouth late in the evening, followed by sips of bicarbonate of soda in water. Early the following morning she suddenly became very restless and noisy, and vomited. Incontinence of urine was present for a short time, followed by complete suppression. The temperature and pulse-rate remained normal. In the evening of the same day the patient had a convulsive seizure in which the head and neck became rigid and the teeth

tightly clenched. Unconsciousness followed, and she died early the following morning, about thirty hours after the administration of the sodium salt, and six days after her admission to hospital.

POST-MORTEM EXAMINATION.—The liver was normal in size and was pale in colour, having a distinctly fatty appearance. Gall-stones were not present in any part of the biliary tract. No undissolved capsules of the drug were found in the alimentary canal. The kidneys appeared normal to the naked eye.

Histological Report on Sections of the Liver and Kidney.—*Liver*: "The appearances are very suggestive of acute yellow atrophy. There seems to have been both cirrhosis and fatty degeneration. The liver is congested, and numerous leucocytes are massed together at the centre of the liver lobules, suggesting a phase of hepatitis, perhaps of portal origin." *Kidney*: "Large hæmorrhagic areas are seen in the kidney, and the tissues show leucocytic infiltration".

COMMENT.—It was difficult to decide whether this case was primarily one of acute yellow atrophy or of simple catarrhal jaundice. The patient did not appear to be very ill, and there was no contra-indication to the use of the sodium tetraiodophenolphthalein. It seems certain, however, that the administration of the drug accelerated the course of the patient's illness and contributed to its fatal ending.

EXPERIMENTAL INVESTIGATION.

Animals Employed.—The effects of intravenous injections of sodium tetraiodophenolphthalein were investigated in both cats and rabbits under various conditions. Cats were selected for the study of the action of the drug upon the pancreas because of the resemblance of their biliary-duct system to that of the human subject. All operations were carried out under ether anæsthesia and with a sterile technique.

Dosage.—A dosage of 0.05 gm. of sodium tetraiodophenolphthalein per kilo. body weight of the animal was employed; when smaller or larger doses were given, reference to that effect is made in the descriptions of individual experiments. The technique of intravenous injection was carried out with the same precautions as in the case of human beings. Some of the experimental animals and their controls were killed with ether, others with hydrocyanic acid.

Chemical Analysis.—This was carried out upon bile, pancreatic juice, and urine. The method was based upon the estimation of the total iodine content of the particular fluid, and was an adaptation of the method recommended by Kendall³ for another purpose.

THE ACTION OF SODIUM TETRAIODOPHENOLPHTHALEIN ON THE PANCREAS.

The Excretion of the Drug by the Pancreas.—Pancreatic juice was collected from the cat by a cannula inserted through the duodenum into the pancreatic duct.

In the cases in which the bile-duct was left patent, none of the drug was detected in the pancreatic juice after an intravenous injection.

In cats in which the common bile-duct was ligatured, and which were given an intravenous injection of the agent, it was found that the pancreatic juice invariably contained small but appreciable amounts of the drug. In

conditions of biliary obstruction the drug was detected at intervals ranging from six to forty-eight hours after intravenous injection. In one sample of pancreatic juice, taken from a cat twenty-four hours after ligation of the common bile-duct and injection of the agent, 0.00011 grm. of sodium salt was found in 1 c.c. of pancreatic juice.

Gross Effects of the Drug on the Pancreas.—

EXPERIMENT 1.—Cat D.C. 1. Weight 3.5 kilo. Inferior pancreatico-duodenal artery perfused with 0.1 grm. of sodium salt in 10 c.c. of physiological saline.

Result.—Death in 10 hours. Diffuse hæmorrhagic extravasation into head and body of pancreas. Widespread œdema of peritoneum and retroperitoneal tissues. Scattered patches of fat necrosis in peritoneum near the pancreas.

EXPERIMENT 2.—Cat D.C. 2. Weight 4.5 kilo. Cannula passed along pancreatic duct via the duodenal papilla; 0.05 grm. of sodium salt in 1 c.c. of distilled water injected very slowly into the pancreatic duct.

Result.—Death in 6½ hours. Hæmorrhagic extravasation into head of pancreas, also at one place in body of organ. Fat necrosis seen in organ itself and in peritoneum at root of the transverse mesocolon.

The above two experiments were undertaken to obtain a measure of the gross action of the drug when it is brought into direct contact with the pancreatic tissues. The results do no more than illustrate the toxic character of the drug when administered in large doses.

The Action of the Drug on the Pancreas in Normal and Abnormal Conditions.—(1) In the rabbit and cat no changes, naked-eye or microscopic, were detected in the pancreas after a single intravenous injection of the sodium salt. (2) In rabbits in which the common bile-duct was ligated before the intravenous injection of the drug, the changes were very striking. Nine such experiments were performed; in four instances the rabbits died within thirty-six hours from acute hæmorrhagic pancreatitis with fat necrosis, local or disseminated. In two instances there was marked swelling and pallor of the gland, with a few patches of fat necrosis on its surface. In the remaining three rabbits no changes were observed.

EXPERIMENT.—Large brown rabbit D.P. 5. Weight 3.2 kilo. Intravenous injection of sodium tetraiodophenolphthalein five hours after ligation of the common bile-duct. Dosage 0.15 grm.

Result.—Died about 14 hours later. Abdominal wall very œdematous in region of operation wound. Peritoneal cavity contained 2 oz. of sero-sanguineous fluid. There was extensive hæmorrhagic extravasation into the head and part of the body of the pancreas. Fat necrosis was present on the surface of the pancreas and in the adjacent peritoneum. A subcapsular hæmorrhage was present in the left kidney.

The above striking effects were not observed in the cat under similar conditions. In this animal the pancreas became a little enlarged; microscopic sections of the organ demonstrated a marked degree of vascular engorgement, but no degenerative changes in its glandular structure.

The Effect of Bile containing Sodium Tetraiodophenolphthalein on the Pancreas.—Cats were used for these experiments.

EXPERIMENTAL TECHNIQUE.—The duodenum was opened opposite the biliary ampulla, and a fine glass cannula was passed into the main pancreatic duct for a distance of half an inch: 0.5 c.c. of bile, withdrawn from the

animal's gall-bladder, was injected by a syringe into the pancreatic-duct system. Very gentle pressure was employed, and twenty to thirty minutes were taken to complete the full injection. When the animal had previously received an injection of sodium tetraiodophenolphthalein, the concentration of the drug in the gall-bladder was estimated chemically in each instance.

The experiment was carried out on five animals. In each case a control experiment was performed with bile uncharged with the sodium salt. In three of the experiments and their controls the animal had been fasting for eighteen hours; in the remaining animals digestion was in progress at the time of operation.

EXPERIMENT.—Female cat, D.P. 5. Weight 2 kilo. Injection of 0.5 c.c. of animal's own bile taken from gall-bladder five and a half hours after an intravenous injection of 0.1 gm. of sodium tetraiodophenolphthalein (0.4 gm. of bile contained 0.0077 gm. of the salt). The pancreas assumed a mottled-brown appearance, due to the bile staining. Within five minutes of the perfusion of bile the overlying peritoneum had become very glazed and œdematous. Within fifteen minutes of the injection the pancreas had become very congested, especially in the region of the head, and a blotchy brick-red discoloration made its appearance. After thirty minutes a few scattered capillary hæmorrhages were noticed in the head of the organ. At the conclusion of the operation the peritoneal œdema and the general blotchy suffusion of the pancreas had increased, and the bile staining had faded considerably.

Result.—Death in 36 hours.

Post-mortem Examination.—Pancreas very red and congested throughout and swollen to twice its normal size. Small areas of extravasation of blood present in head and body of organ. No bile staining persisted. Fat necrosis well marked in upper part of greater omentum, and in peritoneum around the pancreas, especially at the root of the mesocolon.

Microscopic Appearance of the Pancreas.—Gross disorganization of structure. In some places there was massive necrosis of pancreatic lobules; in others only the centre of the lobules showed necrosis. In some parts the pancreas appeared normal. In some areas diffuse extravasation of blood was present, in others merely capillary hæmorrhages. (Fig. 246.)

CONTROL.—Female cat. Weight 2.5 kilo. Injection into pancreatic duct of 0.5 c.c. of animal's own bile. Pancreas coloured yellowish-brown by the injection; twenty to thirty minutes after the injection the pancreas was a little swollen and peritoneal œdema became evident. The pancreatic swelling and œdema were never so marked as in the above experiment, nor was the mottled red appearance reproduced.

Result.—Cat made a quick recovery, took food willingly, and rapidly resumed its normal activities. Killed at the end of two weeks.

Post-mortem Examination.—Pancreas a little swollen and of a pale yellowish-white colour. No fat necrosis present in the pancreas or at a distance.

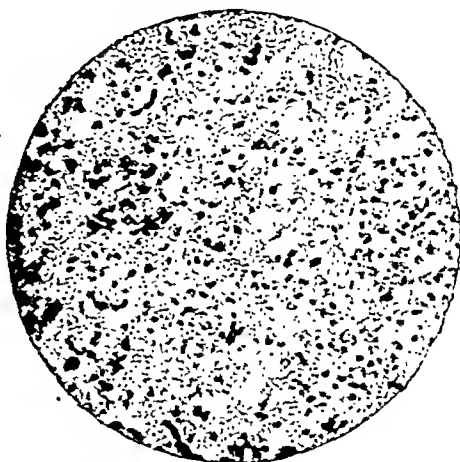


FIG. 246.—Cat D.P. 5. Microscopic section of pancreas of cat which died of acute pancreatitis following injection of 0.5 c.c. of bile containing sodium tetraiodophenolphthalein. Note disorganization and necrosis of pancreas, with extensive hæmorrhages.

Microscopic Appearance of Pancreas.—Slight perilobular œdema was shown. The finer blood-vessels and capillaries were engorged with blood. There were no hæmorrhages. The finer pancreatic ducts were normal in appearance.

The acini of the gland stood out clearly and the component cells were in most places normal; here and there masses of acini showed cloudy swelling and slight hyaline degeneration. In no part was there any cellular necrosis.

In all of the five cats in which the pancreatic ducts were perfused with bile containing sodium tetraiodophenolphthalein, death occurred within two to five days. In each case death was due to acute pancreatitis with fat necrosis. The five animals in which bile alone was employed recovered and were little affected by the operation. No differences were noticed, in the effects on the pancreas, between the animals which were fasting at the time of operation and those which were digesting.

As a further control of the supposed toxic effect of the drug on the pancreas the following experiments were carried out:—

EXPERIMENT.—Cat D.P. 11. Weight 2.2 kilo. Perfusion of pancreatic ducts with 0.5 c.c. of normal saline containing an amount of sodium tetraiodophenolphthalein equal to that present in 0.5 c.c. of bile from the gall-bladder after an intravenous injection of the agent. In this cat 0.008 grm. was employed.

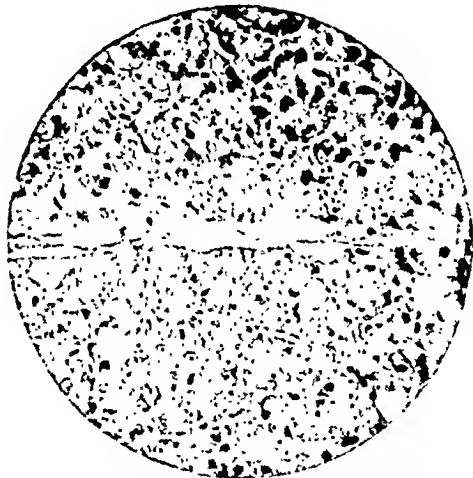


FIG. 217.—Cat D.P. 11. Microscopic section of pancreas of cat after injection of 0.008 grm. sodium tetraiodophenolphthalein in 0.5 c.c. of normal saline into the pancreatic duct. Note cell degeneration and loss of normal acinous arrangement.

Result.—Animal remained very listless and inactive for a few days after operation and took no food; became very thin and weak. Killed on sixth day after operation.

Post-mortem Examination.—Pancreas was about twice its normal size and had a lardy milky-white appearance. The individual lobules of the organ stood out in abnormal prominence and there was a general œdema of the whole organ. Patches of fat necrosis were present in the pancreas itself, in the gastric peritoneum, and around the portal vein.

Histological Appearance of the Pancreas.—There was an almost total loss of the normal acinous structure of the gland lobules. The lobules themselves had the appearance of being fused together. There was a general desqua-

mation of the acinous epithelium, and also of the epithelial lining of the pancreatic ducts. In places whole blocks of acini were undergoing necrosis. Only in a few places were perfectly normal acini seen, and these were mostly at the periphery of the organ. There were no capillary hæmorrhages. (Fig. 247.)

EXPERIMENT.—Cat D.P. 12. Weight 3.2 kilo. Perfusion of pancreatic duct with 0.5 c.c. normal saline. Animal was allowed to recover, and was killed after a week.

Result.—Pancreas looked normal in colour. There was no swelling of the organ and no œdema. No fat necrosis.

Histological Appearance of the Pancreas.—No departure from the normal was detected.

THE ACTION OF SODIUM TETRAIODOPHENOLPHTHALEIN UPON THE LIVER AND KIDNEY IN EXPERIMENTAL COMMON BILE-DUCT OBSTRUCTION.

Gross Effect of the Drug on the Liver.—

EXPERIMENT.—Cat L.V. 3. Weight 3.2 kilo. Left hepatic artery perfused with 0.1 grm. of sodium salt in 5 c.c. of physiological saline.

Result.—Death after 1½ hours. Liver was like yellow ochre in colour, especially the left lobe. Microscopically, the left lobe of the liver showed complete disintegration of its lobular structure: extensive cellular necrosis was present throughout. Similar changes, though less marked, were present in the right lobe.

Effect of the Agent upon the Liver in Experimental Common Bile-duct Obstruction.—As compared with normal animals and control animals, it was found that the drug was badly tolerated in animals in which the common bile-duct had been ligatured previously, collapse and sudden death occurring more frequently after the intravenous injections. Animals in which the common bile-duct was ligated, and which had received three injections of the drug over a period of seven days, showed more advanced degenerative changes in the liver than was the case in normal animals receiving the same dosage.

COMMENT.—These experiments illustrated that the drug had a greater toxicity upon the liver in the presence of obstructive jaundice.

Histological Changes in the Liver of Animals with Common Bile-duct Obstruction after a Single Intravenous Administration of the Drug.—The most constant change was in the cytoplasm of the liver cells, which became cedematous within forty-eight hours, and showed definite granular degeneration with vacuolation; the normal nuclear staining was preserved, and the structure of the liver lobule unaltered. The cellular changes were general in their distribution throughout the organ. (Fig. 248.)

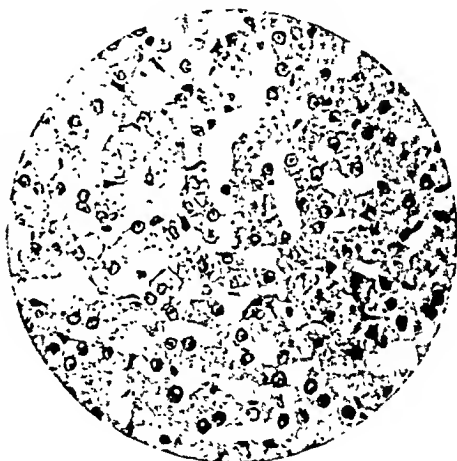


FIG. 248.—Microscopic section of liver of cat, killed forty-eight hours after ligation of common bile-duct and injection of sodium tetraiodophenolphthalein (0.05 grm. per kilo). Note vacuolation and granular degeneration of the cytoplasm, and that the nuclei are unaffected.

The Effect of the Drug on the Kidney in Biliary Obstruction.—The changes observed in the kidney were never more than slight when diagnostic doses were employed. The only constant change seen in microscopic sections was a general vascular engorgement of the whole organ. In a number of cases the glomeruli were swollen and the epithelium of the convoluted tubules showed an early stage of cloudy swelling; the cells of the collecting tubules were unaffected. •

**THE MODE AND RATE OF ELIMINATION OF SODIUM
TETRAIODOPHENOLPHTHALEIN WHEN THE COMMON BILE-DUCT
IS OBSTRUCTED.**

The drug was eliminated almost entirely by the kidneys when the biliary route of excretion was unavailable. The rate of excretion was very slow. The agent was detected in the urine as long as eighteen days after an intravenous injection; 5 to 10 per cent of the salt was excreted by the kidneys in the first twenty-four hours after the intravenous injection. The following table shows the rate of excretion over a period of six days in a cat weighing 3.8 kilo. and in which the common bile-duct was ligated immediately before an intravenous injection of 0.19 gm. of sodium tetraiodophenolphthalein.

| QUANTITY OF URINE COLLECTED BY CATHETER | | | WEIGHT OF SODIUM SALT IN EACH SAMPLE OF URINE |
|--|------------------------|--|--|
| 35 c.c. | } In first 24 hours | | 0.0042 gm. |
| 35 " | | | 0.00325 " |
| 22 " | | | 0.00242 " |
| 18 " | | | 0.00216 " |
| 20 " | | | 0.0018 " |
| 37 " | | | 0.00444 " |
| 14 " | | | 0.00896 " |
| 8 " | | | 0.00044 " |
| 25 " | | | 0.0025 " |
| 40 " | | | 0.0036 " |
| Total 254 c.c. | | | 0.03577 gm. |

Quantity of bile obtained post mortem from gall-bladder and ducts in same animal = 15 c.c.

Quantity of sodium salt in this volume of bile = 0.135 gm.

Hence 0.1708 gm. of the 0.19 gm. administered was accounted for in the bile from the gall-bladder and ducts and in the urine which was collected.

Quantity of the sodium salt excreted in six days = 18.83 per cent, of which 5 per cent was excreted in the first twenty-four hours.

DISCUSSION AND CONCLUSIONS.

From our clinical experiences and experimental findings it appears that the use of sodium tetraiodophenolphthalein in diagnostic doses is not free from risk in certain circumstances.

In the absence of other contributory factors, normal bile containing sodium tetraiodophenolphthalein introduced experimentally into the pancreatic ducts is sufficient to produce acute pancreatitis. It may thus be inferred that in cases of cholelithiasis in which stones are present in the common bile-duct, and the conditions are otherwise favourable for the retrojection of bile into the pancreas, the danger of acute pancreatitis occurring will be much greater if the regurgitated bile contains the phenolphthalein salt.

In obstructive jaundice the normal route of elimination of the drug is unavailable, and small quantities are excreted in the pancreatic juice. In animals with experimental biliary obstruction, especially in rabbits, it was

found that pathological changes occurred in the pancreas, ranging from simple vascular congestion to hæmorrhagic pancreatitis. The conclusion to be drawn from this is that there is risk of damage to the pancreas by the administration of the agent to jaundiced patients who have chronic obstructive lesions of the biliary passages.

Case 3 in the clinical record illustrates the toxic effect of the drug in jaundice. The pathological changes which were experimentally produced in the liver lend strong support to the opinion that the toxicity of the drug on this organ is greater when biliary obstruction is present. In this case, however, the liver was probably the site of a pathological lesion, and it is reasonable to believe that the drug exerts a greater toxicity on an organ whose function is already impaired.

Although the agent is eliminated by the kidney in biliary obstruction, no ill effects apparently ensue in the normal kidney; nor, indeed, is this to be expected, as the rate of excretion is slow.

In justice to this valuable diagnostic method and to its originator it should be emphasized that, in two of the cases we have reported, larger doses than are now known to be safe were employed. The recorded cases were selected from many hundreds in which the drug had been exhibited without ill effect.

SUMMARY.

1. The toxic manifestations which appeared after the administration of sodium tetraiodophenolphthalein in three cases are recorded. In the two fatal cases larger doses than those recommended by Graham were employed.

2. The injurious effects which the agent may in some circumstances produce on the pancreas are detailed.

3. The dangers of the use of the drug in cases of obstructive jaundice are indicated.

4. In obstructive jaundice the drug is eliminated, almost entirely, in the urine. An estimation of the rate of excretion has been given.

5. The results of an investigation into the action of the drug on the normal kidney are described.

We are indebted to Mr. A. A. Scot Skirving for his permission to publish Cases 1 and 2, and to Mr. J. N. J. Hartley for Case 3. We desire to express our thanks to Professor D. P. D. Wilkie for his helpful direction and criticism in the conduct of the experimental work. For his advice and suggestions in connection with the chemical investigations we are obliged to Professor G. Barger.

We owe thanks also to the Trustees of the Moray Endowment Fund and the Medical Research Council for grants which enabled us to defray the expenses of the research work.

REFERENCES.

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² NUTALL, A. W., *Ibid.*, 613.

³ KENDALL, E. C., "The Determination of Iodine in Connection with Studies in Thyroid Activity", *Jour. of Biol. Chem.*, 1914, xix, 251.

RUPTURE OF THE URETHRA.

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"Rupture of the urethra is one of the most serious of accidents, and unless your skill can prevent the development of a stricture, you are presiding at the opening of a life-long tragedy." (*Rutherford Morison.*)

"Every rupture of the urethra, even the slightest, is a potential stricture." (*Boeckel.*)

RUPTURE OF THE BULBOUS URETHRA.

It is doubtful if there is a traumatic lesion in the whole range of surgery where the nature of the violence is as stereotyped as in rupture of the bulb of the urethra. Almost without exception there is the history of a fall astride



FIG. 249.—Complete rupture of the bulb of the urethra. (Blood is trickling from the meatus.) The patient had fallen astride a few hours before the photograph was taken.

a projecting object (*Fig. 249*). The exceptional case is where the patient has received a 'kick in the crutch'. In studying the records of twenty consecutive cases of rupture of the urethra admitted to the Liverpool Royal Infirmary

during the past decade, I noticed that in only one instance was the patient a mariner. In days gone by sailors working aloft were particularly liable to this accident, but with the passing of the windjammer this relatively high incidence has been much reduced. To-day rupture of the urethra is principally an accident of industrial life. A review of any collected series^{1, 2, 3, 4} of cases of this particular accident will reveal that a considerable percentage are boys. This percentage, though noteworthy, is not quite so high as is sometimes stated.⁵ On an average, rather more than one quarter are under eighteen years of age.

Two outstanding features of a ruptured urethra are hæmorrhage via the meatus and the presence of a perineal hæmatoma. Legueu⁶ states that the gravest ruptures have the largest hæmatomas. Within the past year three cases have come under my observation in which the perineal hæmatoma



FIG. 250.—Rupture of the bulb of the corpus spongiosum with extravasation of the blood into the scrotum. In spite of the magnitude of the hæmatoma, the urethral mucosa was hardly damaged.

was very extensive, and in one of these (*Fig. 250*) the extravasation of blood was considerable. Yet on further examination it was found that the mucosa was comparatively intact. It is quite clear that the bulb of the corpus spongiosum may be severely damaged, and its ensheathing envelope broken, whilst the mucous membrane remains untouched.

Hæmorrhage via the meatus is certainly good evidence that the mucosa is involved, but its profusion is no guide to the severity of the rupture. Some time ago I saw a patient who, three days previously, had stepped on to the lid of a pavement coal-hole which was not securely in place, with the result that one leg went down into the cellar whilst the perineum bore the brunt of the fall. For three days severe urethral hæmorrhage had continued, and the patient was profoundly anæmic, yet an exploring catheter readily slipped into the bladder.

Retention of urine is usual after these urethral injuries. It is due to a reflex spasm of the compressor urethræ. Proof of this is afforded by the fact that the bladder is sometimes emptied as soon as the patient is fully anaesthetized (Heitz-Boyer⁷). This spasm of the compressor prevents extravasation for many hours. Extravasation of urine due to a ruptured bulbous urethra is now rarely seen, and usually signifies that the case has been neglected. On the other hand, when the rupture is above the compressor, extravasation into the cellular tissues of the pelvis occurs early (Fig. 251).

The triad of signs of a ruptured bulbous urethra are urethral hæmorrhage, a perineal hæmatoma, and retention of urine—to which may be added a fourth, pain. These, however, afford but little clue to the severity of the mucosal tear. There is as yet no method by which the extent of the lesion can be inspected conveniently. Acro-urethroscopy in the presence of hæmorrhage is absolutely contra-indicated, because of the danger of air embolus. The posterior urethroscope in which water dilatation is used is free from this danger, but this instrument is seldom at hand in an emergency.

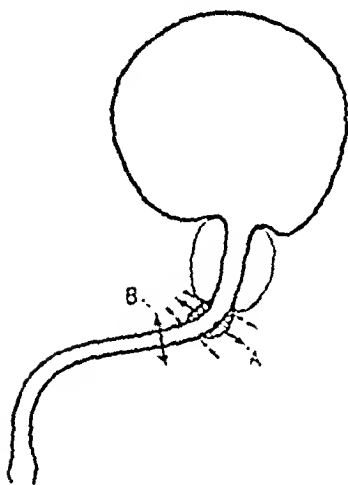


FIG. 251.—Extravasation into the cave of Retzius occurs early when the intrapelvic urethra is ruptured. In rupture of the bulb the reflex spasm of the compressor prevents extravasation for many hours. A, Extravasation early; B, Extravasation late.

The usual method of differentiating between a complete and an incomplete lesion is by sounding, and for this purpose there is no better instrument than the *coudé* catheter, the nose of which can be readily made to follow the roof of the urethra. Instrumentation should only be carried out after the anterior urethra has been thoroughly washed out with a mild antiseptic solution. The almost universal practice of casualty officers and others of attempting to pass a catheter with only ordinary precautions, and the mild infection of the lacerated tissues which thereby ensues,

probably account for a large number of traumatic strictures. The sounding should be carried out in the operating theatre, where asepsis can be assured and operative measures can be undertaken immediately in necessary cases.

If urgent relief of retention of urine is needed before these facilities are at hand, such as may be the case in remote districts or at sea, catheterization is still contra-indicated. The bladder should be emptied by suprapubic aspiration. In cases of ruptured urethra or suspected rupture, promiscuous catheterization must be stopped. The catheter can be withheld, even in the direst emergency under the most extenuating circumstances. A case of what proved eventually to be complete rupture of the urethra occurred on board ship four days out from Havre. Catheterization was not attempted, retention being relieved by repeated suprapubic punctures until the ship reached port, when the patient was transferred to hospital. Extravasation did not occur. (Marion.⁸)

INCOMPLETE RUPTURE.

Incomplete rupture of the urethra is too often looked upon as a trivial accident, especially by the patient, who can only with difficulty be persuaded to attend for regular inspection after he has left hospital. For many years French surgeons, ^{1, 2, 7, 9} who have devoted much thought to this subject, have insisted that the tied-in catheter, and the concomitant infection, is the most potent cause of stricture formation. In this country the tied-in catheter still appears to be much in vogue for the treatment of incomplete rupture. I have seen it in use at every hospital in which I have worked.

Reginald Harrison,¹⁰ as long ago as 1880, advocated perineal section as the safest plan of diminishing stricture formation in these cases. It would be sound teaching to insist that all cases of incomplete rupture in which bleeding from the meatus has occurred require perineal drainage. A catheter brought out in the perineum behind the point of the rupture,¹¹ and retained for forty-eight hours, is not open to the foregoing objection, and can only do good by keeping the urine away from the damaged mucous membrane.

W. J., age 29, complained of increasing dysuria. Four months previously he had fallen astride, and hæmorrhage had occurred from the meatus. He had been treated by an indwelling catheter, and was detained in hospital for a few days. Urethroscopy revealed a dense bulb stricture, and only a whip guide could be passed. Internal urethrotomy and subsequent dilatation proved most satisfactory.

Examples of severe stenosis following an apparently trivial urethral injury are common.

COMPLETE RUPTURE.

The difficulty which is sometimes encountered in locating the posterior end of the divided urethra within bruised, blood-stained tissues, is a byword. Duplay spent one and a half hours, and Desguin¹² two and a half hours, looking for this elusive structure, and many times a fruitless search has been abandoned. In order to overcome this difficulty numerous methods have been devised, some of which are most ingenious.

METHODS OF FINDING THE POSTERIOR END OF THE DIVIDED URETHRA.

1. "Go over the whole area with a director, exploring each orifice, each depression, and each little reddish nodule." (Lejars.¹³)
2. The urethra appears white when sponged clean of blood. (Warren.¹⁴)
3. The vesical end of the urethra will be found further forwards than you are inclined to think. (Current London teaching.)
4. The urethra may be identified by the persistent bleeding of a vessel in its walls. (Thomson and Miles.¹⁵)
5. The assistant should compress the bladder above the symphysis, and the operator watch for the spot where the urine issues in the perineal wound. (De Vlaccos,¹⁶ Cowles,¹⁷ et al.)
6. When the bladder is empty the assistant should compress the vesiculæ with a finger in the rectum.

7. The gloved finger should be inserted into the rectum, and when placed on the apex of the prostate will indicate the exact position of the membranous urethra; by probing at this spot the opening will be found. (Burghard.¹⁸)

8. The completely severed posterior end of the membranous urethra may be discovered by palpation. The urethra will be felt in the perineal floor as a depression with a salient edge. (Mignon.¹⁹)

9. The patient should be given potassium iodide by mouth before operation, and the various likely spots in the perineal wound are touched with lead acetate. The bright coloration of the lead iodide assists in marking the urethra.²⁰

10. By palpation with the volar surface of the finger, the urethra can be rolled under the finger as a somewhat flattened cylindrical mass. The mass is fixed by the fingers against the bone and boldly incised longitudinally. (Van Hook.²⁰)

11. Excise *en masse* the bruised superficial tissues with curved scissors. The aspect of the region changes completely. We see, as clearly as in a dissection, the star-shaped orifice of the posterior end of the urethra under the pubic arch. (Heitz-Bayer.²¹)

12. Identify the transversus perinei muscle, and make a transverse incision behind it. This will open the urethra, and a catheter may then be passed through this opening to the point of the rupture. (Legueu.²²)

13. Suprapubic cystotomy and retrograde catheterization.

It is evident that the length of time taken to find the proximal end of the urethra is likely to be directly proportional to the amount of additional laceration of the peri-urethral tissues. Probing, handling, incising, and douching with chemicals cannot but retard the healing of tissues which have already been grossly insulted; neither can a wound be expected to escape infection when but half an inch distant intrarectal manipulations are in progress.

Retrograde Catheterization is the only method which never fails, and it has long been recognized as a means of dealing with difficult cases. It was first employed by Verguin,²³ of Toulon, in 1757, who, being unable to locate the posterior end of the ruptured urethra, punctured the bladder above the pubis, left the cannula *in situ*, and a few days later passed a catheter through the cannula to the perineal wound.

Until recent years suprapubic cystotomy with retrograde catheterization has been an *ultimum refugium*. Latterly there has been a growing tendency to resort to this excellent method at the first sign of difficulty. Nevertheless, it must be admitted that when resorted to after other methods have failed, the necessary manipulation of the patient from the lithotomy position to the prone and back again to the lithotomy leaves something to be desired, for this change of posture is time-consuming and must endanger asepsis. In no given case is it possible to foretell if difficulty will be experienced in finding the posterior end of the urethra or not. Suprapubic cystotomy and retrograde catheterization circumvents this difficulty; it renders the perineal operation a swift and certain procedure; in addition, by subsequently preventing the passage of urine over the lacerated tissues, it actually

aids the healing of the damaged mucous membrane. Surely the time is long overdue for it to be generally taught that the first step in every operation for complete rupture of the urethra is suprapubic cystotomy.

METHODS OF DEALING WITH THE RUPTURE.

End-to-end Anastomosis.—After Guyon,²⁴ in 1892, had shown the feasibility of uniting the severed ends of the divided urethra, end-to-end anastomosis became a standard method of treating complete rupture. Undoubtedly this method has given numbers of brilliant results. Through the kindness of Mr. Hugh Lett I was enabled to pass a urethroscope on a patient who had had this operation performed twenty years previously by Mr. Mansell Moullin. No sign of stricture could be seen, and a full-sized bougie readily entered the bladder.

Had the operation not given many excellent results, there is no doubt it would have long since perished. Whilst we must acclaim that perfect individual results have been achieved by this technique, it is also certain that dense unyielding strictures have followed its use; indeed, under the most favourable circumstances urethral stenosis follows in two out of three cases. It is this vanguard of strictures which has called the operation to question. Even Guyon eventually began to doubt the advisability of the method. (Iselin,²⁵ Desvignes.¹) For many years end-to-end anastomosis over an indwelling catheter has occupied the pride of place in text-books^{4, 15, 26, 27} and teaching, and, consequently, the practice of British surgery. The end-results have hardly justified this trust. Other methods will therefore be reviewed, indicating as far as possible their relative merits and special uses.

The Sutureless Operation.—Rutherford,⁴ of Glasgow, reported (1904) a very instructive series of cases treated by his sutureless method, which, in principle, is the very antithesis of end-to-end anastomosis. The operation consists of immediate suprapubic cystotomy followed by perineal section. A catheter is introduced from the meatus to the bladder, and the perineal wound left widely open. His argument for omitting suture is that whilst the gap between the ends of the urethra may be considerable when the patient is in the lithotomy position, yet, when the legs are extended, the ends of the urethra will be in contact. The results of his operation appear to be good, for five out of seven cases were found by him to be stricture-free at long intervals after operation. At the present time a sutureless operation is practised at the Besley-Osgood Clinic,²⁸ and the results are reported as being satisfactory.

The sutureless method is undoubtedly *the* operation when extravasation has occurred, for, as Besley emphasizes, suturing is technically impossible in the presence of infection or extravasation. If it is attempted under these conditions, sutures simply cut out and add still further to the destruction and loss of tissues.

Following modern principles, it would be advisable to omit the catheter and to pack the wound lightly for twenty-four hours. It is certainly difficult to dispel the idea of the necessity for a catheter when sutures have been omitted. If the roof has not been stitched, it is only natural to foster a conception that a catheter along the whole length of the urethra

will act as a splint, and this is probably correct. If the catheter is only retained twenty-four to forty-eight hours, it is improbable that harm will result from its use.

Suture of the Roof Only.—Rutherford Morison²⁹ introduced this method, and the principle has received much support from the Newcastle school. The

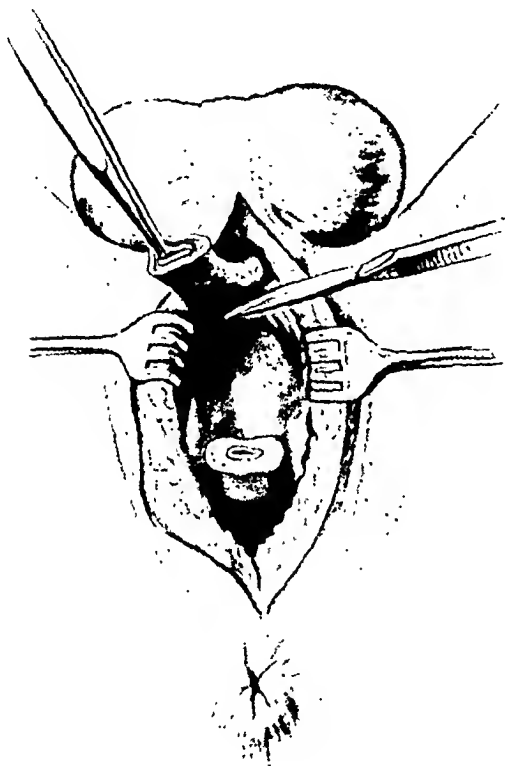


FIG. 252.—Mobilizing the cut end of the corpus spongiosum.
(After Marion.)

roof is sutured by interrupted catgut stitches. If combined with suprapubic cystotomy, the catheter can be completely dispensed with. The wound is left open and lightly packed with moist strip gauze. This appears to be the best operation in those cases which are uncomplicated by extravasation. I have carried it out on three occasions,* and, aided by preliminary suprapubic cystotomy, have found it an easy operation.

Technique.—Preliminary suprapubic cystotomy having been performed, a Lister's sound is introduced down the internal urinary meatus. A liberal supply of gauze is wrapped round the sound, and this forms an excellent protection to the wound during subsequent manœuvres. A towel is then placed over the gauze and the bougie, leaving the handle free for

an assistant to hold. Next the patient is placed in the lithotomy position, and, a second bougie having been passed from the external meatus, the

* AFTER-RESULTS OF THESE CASES.—

Case 1.—The early urethroscopic appearances are depicted in this article (see Figs. 254, 255). It is now three and a half years since the operation. The patient has had no dysuria, and it is eighteen months since bougies were passed. On October 17, 1927, the urethroscopic appearance was much the same as it was three months after the accident (Fig. 255).

Case 2.—Urethroscopy eleven months after the accident. No stricture could be seen. Lister's 14/16 passed readily. Seventeen months after accident 14/16 still passed with ease.

Case 3.—Urethroscopy five months after the accident. Two veil-like folds in the bulbous urethra. Lister's 16/18 passed readily.

perineum is opened by a mid-line incision. Both ends of the urethra are at once accessible. The external bougie is removed, and the assistant is instructed to withdraw the internal bougie until the point is conveniently out of the field of operation. The roof is sutured by interrupted catgut stitches, and, in order to avoid these cutting out, a firm grip of the corpus spongiosum, as well as the mucous membrane, should be taken. After the suturing has been completed—two or three sutures suffice—the wound is lightly packed with strip gauze, and, dressings having been applied, the patient is taken down from the lithotomy position and a suprapubic tube is stitched into place. A De Pezzer's tube is useful for this purpose.

Owing to wide separation of the ends of the urethra, it will occasionally be found impossible to bring the divided ends of the structure into apposition by the method detailed above. In one such case I used a mattress suture, and after this had been introduced, but before it was tied, the patient was moved further up the table in order to lessen tension caused by the lithotomy position. By these means the ends of the urethra could be almost approximated. Ten months later the patient showed no signs of stricture on urethroscopic examination, and a 14/16 silver bougie readily slipped into the bladder.

Probably such an excellent result is due more to luck than to good management. When the ends of the divided urethra are difficult to approximate it would probably be better surgery to mobilize the anterior end of the corpus spongiosum⁴² (Fig. 252) before attempting suture.

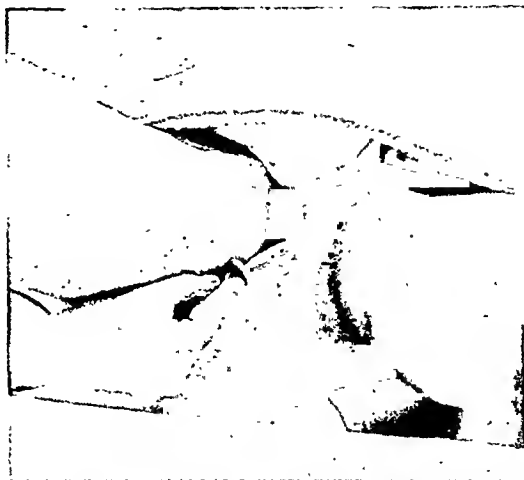


FIG. 253.—Irrigation of the perineal wound with eusol through a Higginson's syringe.

After-treatment.—As suggested by Sir John Thomson-Walker,⁴⁵ the foot of the bed should be raised on blocks, so as to aid the emptying of the bladder by the suprapubic route. The proximity of the perineal wound to the anus makes infection almost a certainty, and special precautions are needed to ensure healthy granulation, which means so much in the prevention of stricture formation. To this end the bowels should be kept confined for the first four or five days; the perineal wound should be irrigated twice daily, and the introduction of eusol solution by means of Higginson's syringe (Fig. 253) has been found a trustworthy method for this purpose. Irrigation should be commenced as soon as the packing is removed, and persevered with for a fortnight.

Not until the twelfth or fourteenth day is it necessary to commence instrumentation. Before this is undertaken the meatus should be cleaned up and the urethra irrigated with a solution of 1 per cent mercurchrome or

1-10,000 silver nitrate. One well-lubricated Lister's sound is introduced, exercising the 'rule of the bougie', *arte non vi*, to its fullest degree.

Frank Kidd³ has laid great stress upon the necessity for a urethroscopic control (*Figs. 254, 255*) in the after-treatment of ruptured urethra. It is only by repeated use of the urethroscope that we can estimate the need or otherwise of dilatation, and judge the end-result of treatment by various methods.

The Method of Pasteau²⁰ and Iselin.—At the initial operation both ends of the divided urethra are sutured to the skin of the perineum. A perineal fistula results. Urethral dilatation is continued weekly, until the tissues around the orifice of the perineal fistula are supple; this usually takes from four to six months. The second stage—a plastic—is then undertaken. A flap of skin is mobilized on each side of the middle line, one of which is hinged medially and the other laterally. These are superimposed one upon the



FIG. 254.—Complete rupture of the bulbous urethra treated by suture of the roof. Urethroscopic appearance during the sixth week after operation.

FIG. 255.—Same case as Fig. 254. three months later. An irregular scar is seen on the floor. A 17/19 bougie passes with ease.

other in such a way as to form a shutter lined inside and outside by skin, and this forms a new inferior wall to the urethra.

A late complication which is often in evidence after this method has been employed is the growth of hair within the new urethra, upon which phosphates are deposited. The growth of hair can be obviated to some extent by treatment of the skin from which the flap is to be made by electrolysis some weeks before the second operation.

This method yields very gratifying results (Savariand²³, Leguen), but it is a long and somewhat tedious process.

Heitz-Boyer's Operation^{21, 31}.—The experience gained by the excision of strictures is the foundation of this procedure. The essential features are the resection *en masse* of the bruised tissues of the superficial perineum and the lacerated portion of the bulb. The anterior end of the divided corpus spongiosum is then mobilized, and an end-to-end anastomosis is performed between healthy portions of the urethra, over a large catheter, which is

removed *immediately* after the completion of the operation. Suture is possible if the gap in the urethra after the resection is less than 5 cm.

Marion, whilst practising an operation on much the same lines as the foregoing, emphasizes the fact that the resection should be reduced to a minimum—merely a trimming of the lacerated ends of the urethra.

Both authors stress the necessity of diverting the flow of urine suprapubically during the process of healing.

INTRAPELVIC RUPTURE OF THE URETHRA.

Intrapelvic rupture of the urethra is a more serious condition than the foregoing. The mortality is higher, the immediate diagnosis more difficult, and the treatment less satisfactory. The lesion is almost always an accompaniment of a fractured pelvis, and shock is often very pronounced. In country districts the accident seems to be characteristic of the hunting field, the horse rolling on the prostrate rider (Bond,³² Wheeler³³, Rousseau³⁴), but in town life street and industrial accidents account for a number of these cases.

Diagnosis.—Signs of fractured pelvis are usually evident. The patient has not passed urine since the accident, and the escape of blood via the meatus is a common occurrence. On examining the abdomen a swelling may be felt in the hypochondrium. Extravasation into the pelvic fascia occurs early, and, curiously, it usually proceeds more on one side than the other (*Fig. 256*)—I have noticed this on two occasions. Unless the rounded dome of the bladder can be palpated distinctly from the rest of the swelling (the extravasation), it is impossible, by clinical methods, to make a differential diagnosis between extraperitoneal rupture of the bladder and intrapelvic rupture of the urethra. In this variety of rupture of the urethra there is no perineal swelling, but ecchymoses may be present. (Masmonteil.³⁵)

Treatment.—The investigation of the case should, as in the preceding type, be undertaken in the operating theatre whenever possible. Deanesly³⁶ warns us to be watchful lest the passage of a catheter into the prevesical space, and the withdrawal of a few ounces of blood-stained urine from this situation, be mistaken for an entry into the bladder. This is a trap into which many have fallen.

The operation is commenced by making a suprapubic incision which opens the cave of Retzius. Usually, only after this has been done is it possible to distinguish between an extraperitoneal tear of the bladder and an intrapelvic rupture of the urethra, and even then, amidst the blood-stained effusion, it may not be easy to determine the exact site of the lesion. The guiding rule is: if the bladder is even moderately distended,

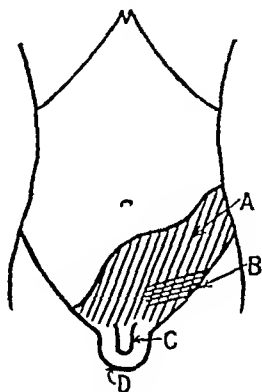


FIG. 256.—The physical signs recorded in a case of intrapelvic rupture of the urethra complicating a fractured pelvis. A, Deep-seated swelling (tender); B, Superficial bruising; C, Blood from meatus; D, Perineum nil. There was grating on compressing the iliac crests.

the lesion must be situated below the vesical sphincter.³⁷ Thus the diagnosis of intrapelvic rupture of the urethra is confirmed. (*Figs. 257, 258.*)

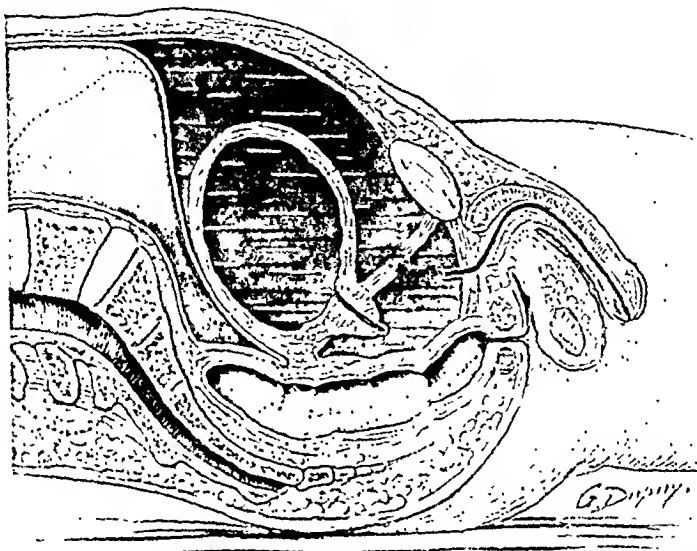


FIG. 257.—Intrapelvic rupture of the urethra. The puboprostatic ligaments are torn, and the bladder, which may be moderately distended, becomes displaced backwards. (*Cf. Fig. 258.*)

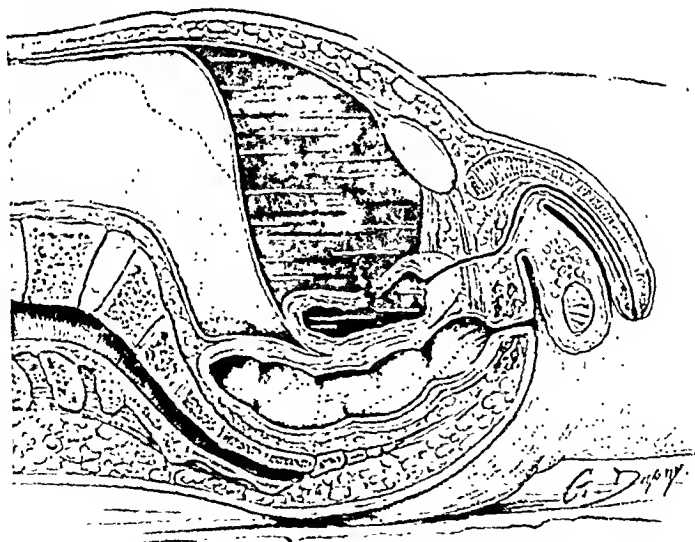


FIG. 258.—Extraperitoneal rupture of the bladder. (*Cf. Fig. 257.*)
The bladder is empty or practically so.

The immediate treatment of this accident is often limited to suprapubic cystotomy and drainage of the cave of Retzius. Whilst this measure

commonly saves the life of the patient, it should be emphasized how essential it is to go further and make some provisions for the restoration of the continuity of the urethra before it is too late.

Intrapelvic rupture of the urethra frequently occurs at the apex of the prostate—in other words, the prostatic urethra is severed from the membranous portion. In addition, the puboprostatic ligaments are torn (Deaunesly,³⁶ Hartley Anderson³⁸). The loss of these ligaments, aided no doubt by the pressure of the extravasated products in the cave of Retzius, causes the neck of the bladder, with the prostate, to become displaced backwards (*Fig. 259*). It is this backward displacement which accounts for the hopelessness of remote restoration of the continuity of the canal; and if it is not rectified at the initial operation or very soon afterwards, we are bound to meet with the following depressing aftermath, which must be fairly common, for I have encountered three examples, and have been responsible for one:—

A boy presents himself at surgical out-patients with a suprapubic fistula. The sinus is unhealthy and discharging purulent urine. He may have been fitted with a permanent suprapubic belt, but the reason for his appearance is that the fistula has closed down and will not admit the catheter. An examination of the perineum reveals an old scar, and there is a history of a fractured pelvis, rupture of the urethra, suprapubic drainage, and drainage of the cave of Retzius. At a later date (usually when the fracture has united) an attempt, or more often several attempts, have been made to restore the continuity of the urethra, but without success. Continually wet and smelling of urine, subject to recurrent attacks of cystitis and pyelitis, these cases are poignant examples of what Rutherford Morison so aptly refers to as 'life-long tragedies'.

Permanent suprapubic drainage is therefore most undesirable, especially in a young subject. It *can* be prevented, but only by correcting the backward displacement of the neck of the bladder before it becomes anchored in its abnormal position. If this correction is carried out at the time of the initial operation or very soon afterwards, there is every hope of eventually restoring the continuity of the urethra.

Methods of Correcting Backward Displacement of the Neck of the Bladder.—

Direct Suture of the Urethra.—At the present time it can hardly be said that direct suture of the intrapelvic variety of urethral rupture is very practicable. The patient is almost always considerably shocked—shock is very much more pronounced in this type of rupture than in rupture of the bulbous urethra. We are thus prohibited from attempting a deliberate operation. Direct suture of the intrapelvic variety of rupture must always be deliberate, for it is, at the best, a difficult procedure which must be conducted at the

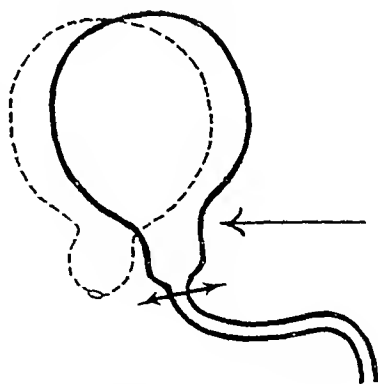


FIG. 259.—The mechanism of backward displacement of the bladder. The urethra having been severed near the apex of the prostate, and the puboprostatic ligaments having been torn, the pressure (arrow) of the extravasated products in the cave of Retzius causes the neck of the bladder to be displaced backwards.

bottom of a deep and hæmorrhagic cavity. A transverse incision close to the anus,⁴⁰ the use of Young's prostatic retractor (Hartley Anderson³⁸), and the very exaggerated lithotomy position (Gaub⁴¹) are lines along which these technical difficulties will eventually be overcome. The probable solution of the major difficulty—namely, shock—lies in a two-stage operation, whereby the bladder and the cave of Retzius are preliminarily drained, and forty-

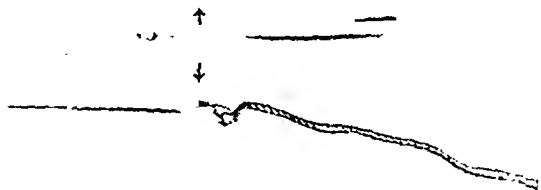


FIG. 260.—The bulbous extremity of the gum-elastic catheter is cut off and a length of silk is attached to the cut end. The catheter may then be changed by the 'railroad' method.

eight hours later the periurethral stage is undertaken. This, theoretically, overcomes the principal obstacle, yet in practice we may find that at the end of forty-eight hours the patient is still unfitted for a major procedure. Even if this is not the case, it is possible that permission for further operation may not be granted. Two-stage operations with a short intermediate phase seldom retain a permanent place in accepted surgical methods.

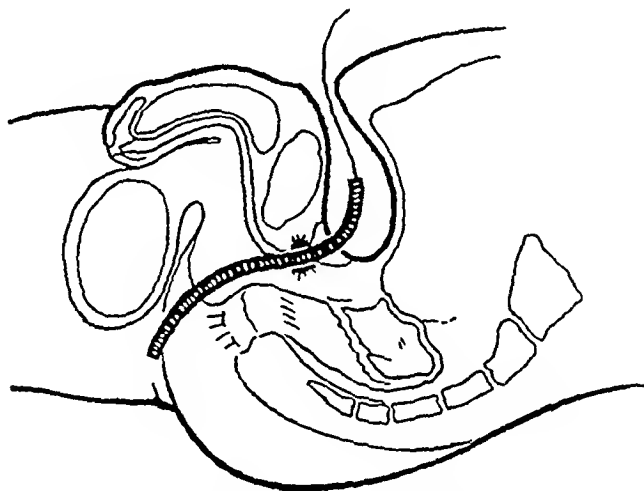


FIG. 261.—Complete intrapelvic rupture of the urethra. Backward displacement of the neck of the bladder corrected by an indwelling catheter. Note the silk attached to the catheter to facilitate changing.

Correction by an Indwelling Catheter.—Backward displacement can be corrected by the simple expedient of passing a retrograde bougie and cutting down upon this in the perineum. A gum-elastic catheter is then passed from the bladder to the perineum. Before introducing the catheter it is a wise precaution to cut off the dilated extremity and to pass a needle carrying silk

through one side of the cut end (*Fig. 260*). If the silk is left hanging out of the suprapubic wound, the catheter can subsequently be changed by the 'railroad method'.

Bond³² has pointed out that in order to introduce the catheter it is not even necessary to put the patient into the lithotomy position. The sound may be cut down upon after gently separating the partially flexed thighs. Even in the gravest cases this additional manipulation can add but little to the time and shock of the operation. Once a catheter has been passed from the bladder to the perineum, the posterior end of the urethra is under control (*Fig. 261*).

If time permits, the catheter can be threaded through the whole length of the urethra and made to emerge at the external urinary meatus; but there is no advantage to be gained by this in the early stages of treatment.

After all the condemnation the indwelling catheter has received in the earlier part of this paper, it may at first sight appear inconsistent to terminate by advocating its use. I therefore hasten to emphasize that the *only* indication for the retained catheter in urethral injuries is in a complete *intrapelvic* rupture. We are dealing here with a very grave and desperately urgent accident, where simplicity of technique is of paramount importance. Fortunately, it so happens that the very objection to the retained catheter—i.e., its stimulating effect on formation of fibrous tissues, of such great moment in lesions of the bulb—is of practically no account here. *The membranous urethra, unlike the bulbous, shows very little tendency to stricture formation.*² Apart from this fortunate coincidence, the indwelling gum-elastic catheter, in its rôle of correcting backward displacement of the bladder, more than justifies its place as a standard method of dealing with this difficult situation.

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CONGENITAL ABSENCE OF THE HUMERUS.

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For some reason unknown, congenital absence of the humerus would appear to be the rarest of all defects of the long bones. Congenital absence of the ulna is also a rarity, whereas a total or partial defect of the radius, which is generally associated with club-hand, is of commoner occurrence. Bibliography is very scanty. Gittings¹ quotes a case of congenital absence of the humerus with a rudimentary attempt at radius and ulna. Herczinger² quotes a case of congenital absence of the humerus alone. Unfortunately I have not been able to verify this reference. Ollerenshaw³ has seen a case of bilateral absence of humerus, ulna, and radius—the hands being attached to the shoulders. Sir Arthur Keith tells me that there is no instance of the condition in the R.C.S. Museum, but that one skeleton of a full-time child has a humerus represented by a bar of fibrous tissue. In the case of Gittings there was no articulation at the shoulder-joint, the union being purely fibrous. As regards etiology, he states four admissible causes—maternal impressions, intra-uterine constrictions, local arterial disease, or some deficiency in the original germ cell. Successful radiographs were not possible.

A boy of 8 (*Fig. 262*), one of a family of three, apart from the deformity is strong and healthy, and was born at full time. A sister suffers from poliomyelitis. The mother tells me that there has been no deformity to her knowledge either in her family or that of her husband. She states that she had a fright at the fourth month of pregnancy with this child.

Radiographs show partial absence of the ulna at its lower third, and the



Fig. 262.—Shows limit of passive extension and adduction.

bone is small. The radius is boomerang-shaped, disproportionately large, and its upper end overlaps the upper end of the ulna (*Fig. 263*). The articulation of which the upper end of the radius comprises the greater part, would appear to rest on the axillary border of the scapula an inch below the ill-developed glenoid. There is marked ulnar deviation of the hand. In the position of rest the arm is held 30° in abduction from the shoulder and in full supination, so that the palm of the hand is held square to the front. Passive extension of the arm is not possible beyond the mid-axillary line.



FIG. 263.—Shows false joint below the glenoid cavity, also the defect of the lower end of the ulna.

Voluntary Movements.—Abduction to 90° is possible, but only when the arm is flexed to 45° in front of the mid-axillary line. It would appear that the pectoralis major primarily fixes the upper end of the arm into position beneath the glenoid, and that abduction is then produced by the rotators of the scapula. The boy has all the scapular muscles, and individual action was examined of the trapezius, supra- and infraspinatus, latissimus dorsi, and subscapularis. Flexion of the arm to 80° is brought about through the agency of the major pectoral. Metcarpo-phalangeal and interphalangeal movements are good, but opposition of the thumb is imperfect. Dorsiflexion of the wrist is impossible, and flexion is limited, being only 75 per cent of normal. The child can use the hand quite well, and when a coin is held in front of him he will take it from the donor and transfer it to his upper outside jacket pocket with creditable speed.

My thanks are due to Dr. Llewellyn Williams, D.S.O., of Mountain Ash, who brought the case to my notice.

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TORSION OF THE GREAT OMENTUM: A NOTE ON TWO CASES.

By CHARLES MacAULEY,

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THE literature on torsion of the great omentum is sufficiently scanty to justify putting on record two cases which have recently occurred in my own practice. In view of the fact that these are the only cases of the kind with which I have come in contact, their occurrence in rapid succession bears out the experience of most surgeons that rare conditions not infrequently appear in groups.

Case 1.—P. K., male, age 25, was admitted to Mater Misericordiæ Hospital on April 15, 1927. There was a history of vague dyspepsia for some years. On the previous morning he experienced a sudden, not very severe, pain in the right iliac region. Shortly after the onset he took castor oil, and the bowels moved the same day, but without relief of the pain. He vomited once. The patient was a small slim man; pulse 86, temperature 100°, respirations 20; tongue furred; abdominal movement restricted. Slight rigidity and marked tenderness in the right iliac fossa. No hernia. A diagnosis of acute appendicitis was made.

OPERATION.—The abdomen was opened by a right pararectal incision. When the rectus muscle was displaced inwards one noted, with surprise, distinct œdema of the peritoneum. When the peritoneum was opened some blood-stained fluid escaped, and one immediately felt a finger-like thickening adherent to the anterior abdominal wall just within the line of incision. The thickened structure was easily freed and delivered, when it was found to be a portion of the right margin of the omentum, which was purple and strangulated from a twist at its base. The affected portion of omentum was removed, as was the appendix, which appeared congested. The abdomen was closed.

The patient made a good recovery and was discharged on April 28.

Case 2.—P. G., age 48, a very stout man, was admitted to Mater Misericordiæ Hospital on May 25, 1927. He had experienced a dull pain about the umbilicus on May 21; he took Epsom salts and the bowels moved on the 23rd, but the pain was unrelieved. There was no vomiting. Pulse 100, temperature 99°, respirations 24; tongue furred; abdominal movement restricted. An indefinite but very tender mass was felt in the right iliac fossa, and there was an old-standing right inguinal hernia. Diagnosis: acute appendicitis? with abscess.

OPERATION.—The abdomen was opened by a transverse incision on the right side just below the umbilicus. There was well-marked œdema of the parietal peritoneum and extraperitoneal fat. When the peritoneum was opened blood-stained fluid escaped, and a purplish mass presented, which in the light of my former experience I quickly recognized as strangulated omentum. The mass was widely adherent to the anterior abdominal wall, but was freed and delivered with remarkable ease. The right side of the omentum was involved. The mass was ligatured below the twist and removed. Its appearance is well shown in *Fig. 264*.

The patient made an excellent recovery, and was discharged on June 12.

The clinical picture of this condition is well described by Cowell in the *BRITISH JOURNAL OF SURGERY*,¹ to which the reader is referred for a complete account and an excellent bibliography. In my first case the diagnosis of acute appendicitis was made with confidence; the second case was thought to be one of appendicular abscess on account of the tender mass, although a little reflection might have suggested that the development of such a large mass was rather rapid for a case of appendicitis. In both cases the right portion of the omentum was involved, the strangulated part being in the first case only a slender process, and in the second a mass the size of two fists—



FIG. 264.—Front and back views of the portion of omentum removed in Case 2.

a difference which corresponds with the build of the patients, one being very slim and the other very stout. In the second case a hernia was present, but it bore no apparent relationship to the twist. In both, the affected portion of omentum was adherent to the anterior abdominal wall, which sufficiently explains the parietal œdema noted in both. The lightness of the adhesions—a characteristic feature of these cases—was as remarkable as it was gratifying. The presence of œdema was particularly puzzling in the first case, where operation was performed on the second day of the attack, as one associates this condition only with a neglected appendicular abscess. The presence of such early œdema, especially when followed by

the exit of blood-stained peritoneal exudate, should render one alive to the possibility of omental torsion in urgent abdominal operations. It is conceivable that the condition might be overlooked when the abdomen is opened by a gridiron incision, especially if, as in my first case, the affected portion of omentum were quite small and operation were carried out very early in the attack.

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THE STABILIZATION OF THE FLAIL LEG.

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THIS communication constitutes a plea for the revision of the accepted views on the subject of arthrodesis of the knee in cases of extensive infantile paralysis of the lower limbs. The advocacy of such a procedure depends on the recognition of two essential principles: (1) Patient treatment on accepted lines, together with the correction of deformities where necessary, must prove the impossibility of any further return of muscular power; and (2) Such treatment must be carried out under supervision for some years—a minimum of two years has been arbitrarily chosen as the time limit beyond which further improvement is not to be expected.

The cases selected for operation fall into two groups: (1) Those where the lesion in the cord is so extensive that there is no return of muscle power whatever; and (2) Where the degree of recovery is so small that the limb can never support the body weight without the help of irons so cumbersome as to constitute a serious impediment to walking. Practically all the cases quoted fall into the first group; in the second group judgement should err on the side of conservatism. The aim of the operation must be solid bony union at the knee-joint, and the achievement of this must be certain. Such absolute certainty can only be ensured by the use of a bone-graft. The writer has used this method for eight years, and has had no failure of bony union.

THE OPERATION.

The operation is performed throughout after a tourniquet has been applied. If no blood is lost the whole procedure can be carried out at any age, under gas and oxygen anaesthesia, with no shock and the minimum of disturbance to the patient.

1. A small spicule of bone, together with the overlying periosteum, is removed from the crest of the tibia. The graft is about three inches in length, and need be no more than a third to one quarter of an inch in thickness; it is preserved in dry gauze, and the wound closed. It is immaterial whether the graft be taken from the leg to be operated on or from the other side. The use of a chisel or the Albee saw is a matter of choice.

2. The knee-joint is exposed by the usual semicircular incision, dividing the ligamentum patellæ. All cartilage is removed from the articular surfaces of the patella, condyles of the femur, and the tibia, together with the semilunar cartilages. With a fine gouge, a hole is drilled through the epiphyses of both tibia and femur, and the graft is inserted well into the diaphysis of both bones. Over this graft the knee is straightened and the denuded

surfaces are approximated. The capsule and ligamentum patellæ are closed by a continuous catgut suture, and the skin is closed by a subcuticular salmon-gut stitch. After a firm bandage has been applied the tourniquet is released and the limb put into a light plaster splint with a window at the operation site. When the swelling has subsided (in about ten days or a fortnight) a fresh plaster is applied, which is removed in two months. Bony union has then occurred throughout the whole extent of the denuded articular surfaces.

Though there has been no failure to obtain ankylosis in any of the series, a few cases will be reported which illustrate instructive points relating to the selection of cases and operative details. I have been unable to follow up several cases that were operated upon seven or eight years ago, but in two of these the end-result was instructive.

1. In two instances in the earliest cases *post-operative swelling and œdema* was marked. The first instance was that of H. A., male, age 12 years. Massive œdema lasted as long as I had him under observation. After some years I lost sight of him and could not trace him. I had reported the œdema as permanent; but, by a curious coincidence, he came to consult me about his leg, and I have revised and rewritten his case. The œdema has completely disappeared with the lapse of time; but the growth of the limb has taken place so irregularly that there is a marked genu valgum deformity of about 30°. It is difficult to understand why this overgrowth of the internal condyle should have taken place, since the skiagram (Fig. 265) shows the graft inserted centrally. Also it is the only instance of such a deformity in the series.

The second instance was that of M. P., female, age 14 years. Extensive involvement of the lateral-horn cells was evidenced by the coldness and blueness of the limb, as well as by the liability to recurrent chilblains. She had never walked without support, and there was no reaction of the muscles to faradic stimulation. In 1919 a bone-graft was removed from the sound side and arthrodesis performed in the manner described. Arthrodesis of the ankle-joint was performed in 1921. This girl, now 21 years of age, consulted me this year for persistence of the massive œdema, which rendered the weight of the limb (now stable and straight) a considerable disability in walking.



FIG. 265.—Shows bony result eight years after operation (22 years of age).

These are the only two cases in which the end-result has been vitiated—one by irregular growth and the other by persistent massive œdema. In the first case the post-operative œdema may have been due to the tourniquet, but in the second case this cannot account for its persistence for so many years. I believe that extensive vascular changes and chilblains are a contra-indication to this operation. Blueness and chilblains on toes or feet do not necessarily contra-indicate operative measures, since several cases of this type have ended satisfactorily without any such complication; but extensive vascular changes in leg and thigh are to be considered an unfavourable sign.

2. That very extensive *paralysis, marked wasting, and shortening* may be greatly benefited by this operation is shown by the following case:—

CASE 1.—B. D., male, age 8½ years. Severe poliomyelitis affecting the right limb at 3½ years. Treated continuously in the out-patient department for five years with no improvement. Never walked without splints. Left leg unaffected. On Sept. 16, 1918, the electrical reactions showed only a flicker in the hamstrings. On Oct. 8 arthrodesis of the right knee was performed, a large bone-graft being taken from the left tibia. On Nov. 11 the limb was put up in a plaster-of-Paris splint. Firm bony union resulted.

Operation for arthrodesis of the ankle-joint was performed in 1919 (a year later). Skiagrams showed the size of the bone-graft to be unnecessarily large. This patient was kept under observation for some years, but has recently been lost sight of. In spite of great shortening and wasting, he ran very quickly and played football. He has never worn any supports since his first operation.

3. In this case I determined to see whether the introduction of a bone-graft, *without denuding the cartilaginous surfaces*, could effect a bony union. The details are as follows:—

CASE 2.—K. A., female, age 8 years. Severe poliomyelitis in babyhood (at 2 years) involving both lower limbs. Treated (first at another hospital, and subsequently at Great Ormond Street) with massage, electricity, correction of deformities by splinting, tenotomies, etc.

Jan. 8, 1919: The electrical reactions were as follows: *Right limb*: adductors and hamstrings active, also flexors of toes. *Left limb*: paralysis complete. The child had never walked without supports, which were constantly under repair as she grew bigger and heavier. She developed into a very heavy child.

Feb. 10: A large graft, ½ in. by ½ in., and 4 in. in length, was removed from the right tibia. No cartilage was removed from the left knee-joint, but the graft was inserted, and the capsule and skin were sutured in the usual way. The limb was placed in plaster-of-Paris. The gradual absorption of the intra-articular portion of the bone-graft (presumably by the action of the synovial fluid) is shown by the skiagram of the knee-joint (Fig. 266) two or three months later. The intraosseous



FIG. 266.—Case 2. Shows the result of bone-grafting without denuding the cartilaginous surfaces, i.e., the portion of the graft which lies in the joint cavity becomes gradually absorbed and full movement is ultimately established.

Feb. 10: A large graft, ½ in. by ½ in., and 4 in. in length, was removed from the right tibia. No cartilage was removed from the left knee-joint, but the graft was inserted, and the capsule and skin were sutured in the usual way. The limb was placed in plaster-of-Paris. The gradual absorption of the intra-articular portion of the bone-graft (presumably by the action of the synovial fluid) is shown by the skiagram of the knee-joint (Fig. 266) two or three months later. The intraosseous

portions of the graft are plainly visible. Complete movement at this joint was then restored. This simplification of the operation failed to achieve the desired result.

Oct. 14, 1920 : Arthrodesis of left knee. Bone-graft removed from left tibia. Left knee-joint opened through the old wound, the cartilaginous surfaces denuded, and the graft inserted as before. The limb was placed in plaster-of-Paris with windows at the site of both wounds. Bony union resulted, as shown by skiagrams taken in June, 1922 (*Fig. 267*), and in April, 1923 (*Fig. 268*).

June 12, 1922 : Operation for arthrodesis of left ankle-joint and tendon fixation.

Previous to operation this child had only been able to drag herself about laboriously and with infinite physical effort with cumbersome irons connected by a pelvic band, and with the aid of two sticks. Now she can stand unsupported



FIG. 267.—Case 2. Shows the same case as *Fig. 266*, where, subsequently, the cartilaginous surfaces were denuded and the bone-graft inserted—complete bony union resulted.



FIG. 268.—Case 2. Shows the same as *Fig. 267*, ten months later. The evidence of the several grafts is still visible, but the epiphyseal line appears little affected. The relative length of the two limbs appears to be unaffected (both being extensively involved).

and walks alone with light supporting irons on the right limb. In evidence of the firmness of the bony union resulting from this operation, it is interesting to note that in April, 1921 (six months after arthrodesis of the left knee), this child slipped and broke the left leg at the junction of the middle and upper thirds of the tibia—not (as might have been expected) at the site of the bone-graft.

Further treatment was directed towards correction of deformity and maintaining good position in the right limb. This patient is now a big and heavy girl, but is able to get about satisfactorily with no support to the left limb.

4. The next case is of interest from the point of view that sufficient damage may be done to the epiphyses of the femur and tibia by this operation to retard or impair growth in a limb whose growth has already been impaired

by the disease. This is an exceedingly difficult point to assess at its true value. In the cases so far reported the graft used was large; but, in the face of such uniformly satisfactory union, progressively smaller grafts have been used—indeed, a spicule of bone is all that is necessary. If the whole extent of each epiphysial surface is borne in mind, it is clear that only a very small area is damaged by the graft, and little, if any, interference with growth should be expected. When both limbs were extensively involved (as in *Case 2*) I could not satisfy myself that there had been any material impairment of growth after two operations by bone-grafting.

CASE 3.—C. D., male, age 10 years, was under treatment on the fifth day of illness at the age of 1 year and 5 months. He was treated continuously under my care for nine and a half years. The disease only involved the right limb, in which (after this



FIG. 269.—*Case 3.* Shows the graft seven weeks later—commencing bony union can be seen.

time, November, 1923) there was only a weak adductor and flexor response. The limb, otherwise completely flail, was the seat of obstinate chilblains and was blue and swollen in its lower third.

Nor. 12, 1923: Arthrodesis of the right knee. A thin bone-graft from the tibia of the affected side was used. *Fig. 269* shows the result seven weeks later; commencing bony union can be seen. *Fig. 270* shows the X-ray appearances on Nov. 13, 1924, or a year after operation. Complete bony union has taken place, the graft has nearly disappeared, and the epiphysial line appears hardly disturbed. *Fig. 271*, taken in 1926, illustrates the stability of the limb and also gives a comparative picture of the normal with the affected side.

In November, 1923, the right limb was an inch and three-quarters shorter than the left, while in October, 1925, there was three inches of shortening,

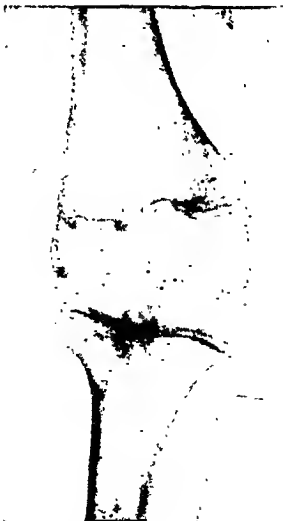
i.e., an inch and a quarter increase in shortening in two years. The photographs showing the comparative integrity of the epiphyses and the extent of the paralysis and vascular disturbance in the limb would lead one to believe that most of this shortening must be attributed to the disease rather than to the operation.



FIG. 270.—Case 3. Shows the result one year later.



FIG. 271.—Case 3. Shows the final degree of stabilization achieved. Note the poor condition of the limb and unhealed chilblain.



FIGS. 272, 273.—Case 4. Show the result three years after operation.

5. The disappearance of the bone-graft and the integrity of the epiphysial lines are also well illustrated in a younger subject.

CASE 4.—K. P., female, age 6 years. April, 1920: Arthrodesis of right knee—bone-graft from the left tibia. A skiagram taken three months later showed that bony fusion was incomplete. *Figs. 272 and 273* (taken three years later) show the disappearance of the bone-graft to be nearly complete, and the epiphysial lines practically intact.

CASE 5.—L. B., female, 11 years and 3 months. Infantile paralysis, affecting the right leg only, at 4½ months. Arthrodesis performed on the right knee for flail limb nearly eleven years later (the ankle-joint had previously been fixed). Bony

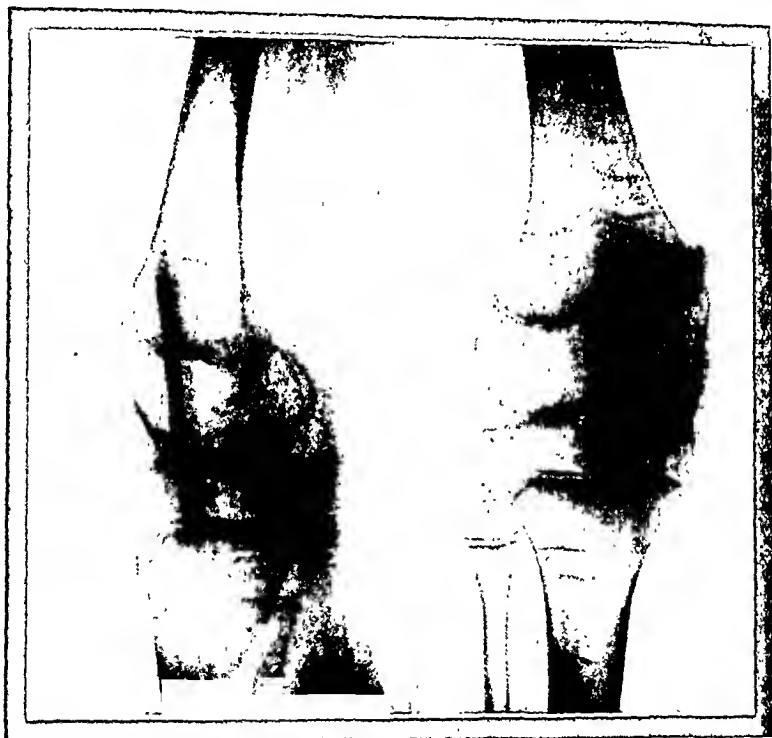


FIG. 274.—Case 5. Showing bony union established in about three months.

union had taken place in three months. It is to be regretted that previous measurements of the two limbs are not recorded, but two years later the difference was two inches.

The degree of paralysis can fully account for this amount of shortening, which compares quite favourably with many cases not submitted to operation. It would appear that damage to so small an area of the epiphysis can hardly have contributed to any great extent. *Fig. 274* shows the condition of the bones and graft three months after operation.

6. The remaining two cases to be reported are of interest from the fact that both were operated on within a week. In the first instance the graft was deliberately inserted through both epiphyses; in the second an effort

was made to preserve their integrity. This difference in the usual procedure was intended to ascertain: (1) Whether there was any ascertainable interference with growth arising from epiphysial injury; and (2) Whether the contact of the graft with the diaphysial side of the epiphysis influenced the rate or completeness of ossification.

CASE 6.—B. S., female, age 9½ years. Onset at 2 years and 8 months. Right limb under treatment from six weeks after onset. Shortening of the right limb was two inches, and the only serviceable muscles were the hamstrings.

Oct. 29, 1923: Arthrodesis of the right knee. In this case the graft was deliberately introduced through the epiphysis of femur and tibia. Union did not take place until the lapse of three months, and the patient was not allowed to walk until five months after the operation.

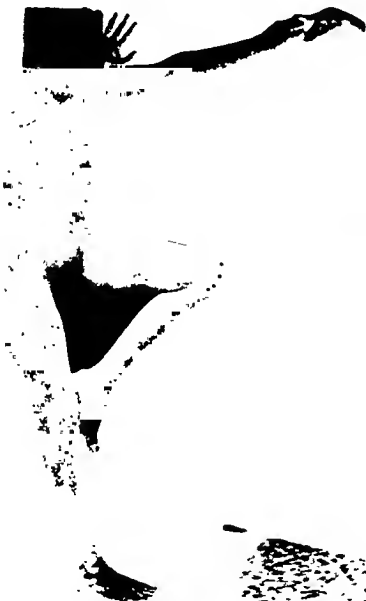


FIG. 275.—Case 6. Shows the degree of stabilization achieved. Note the slight and persistent swelling of the affected limb.



FIG. 276.—Case 6. Shows the child's ability to stand on the stabilized limb with practically no support.

A skiagram taken two years later showed that the graft had nearly disappeared, the epiphysial lines were almost intact, and there was no line of differentiation between the tibia and the femur. The affected limb is three and a quarter inches shorter than the sound limb. Two years after operation this child fell down and complained of pain in the right knee. Physical signs and skiagrams were negative, and she rapidly recovered.

Figs. 275 and 276 show the result three years later. Though she had never walked without supports, this child has now been walking without splints for over two and a half years. There is a little permanent swelling of the limb, but this is not sufficient to cause any disability or inconvenience.

CASE 7.—K. W., female, age 7 years and 9 months. Onset at 8 months. Both limbs extensively paralysed. Treated for nearly seven years. There was no muscular power below the knee on the left side, and very little on the right. The thigh muscles were good on the right side, and almost absent on the left. The left leg was one inch shorter than the right.



FIG. 277.—Case 7. Shows the graft immediately after operation. It will be seen that the graft inadvertently encroached upon the tibial epiphysis.

Nov. 5, 1923: Arthrodesis of left knee. In this instance every care was taken to avoid injury to the epiphyses concerned. It will be seen in Figs. 277 and 278 that after the introduction of the graft the epiphysis of the tibia appears to have been accidentally encroached upon in the approximation of the denuded surfaces over the graft. The shortening remained the same after operation.

Union took place six weeks after operation, and a skiagram taken two weeks later showed bony union had taken place but was not complete over the whole articular surface. Further skiagrams showed the condition of the bones

and epiphyses five months after operation: bony union was complete, but the line of union was still evident. The epiphyses were practically normal. Fig. 279 shows the final result nearly two and a half years after operation.

This child had never walked without help, but now has walked for over two years without any appliance on the left leg and with the help of irons on the right leg. Fig. 280 shows the degree of stability attainable in a completely flail leg.

Tendon fixation has been performed by threading the distal ends of the divided extensors through a tunnel in the lower end of the tibia—half being brought through one way and half through the other—and fixed at the desired tension. The proximal ends have been then attached to their fellows below the site of the fixation to the tibia. In cases of lateral instability or deformity, a subastragaloid fixation or a further ankylosis (by Dunn's operation) may be necessary at a later age.

My colleague, Mr. Fairbank, with whom I have frequently had the privilege of discussing this question, is not in sympathy with arthrodesis at the



FIG. 278.—Case 7. Shows the condition of bones and graft after two months.



FIG. 279.—Case 7. Shows the condition of bones and graft after two and a half years.

ankle-joint. He thinks the ankle-joint is loose in the minority, while in the majority the normal range of hinge movement only is allowed. Accordingly he prefers Dunn's operation alone and abstaining from any attack on the ankle-joint. This can be combined with a toe-elevating strap for walking in cases of marked foot-drop. With these views I agree in cases where some muscular power exists; but in completely flail limbs I believe arthrodesis of the ankle combined with tendon fixation is of distinct benefit, and avoids the necessity for toe-elevating devices. This, after all, is the object of operating.

Treatment of the Foot.—Since the object of operation is the elimination of splinting, some form of stabilization of the foot is called for. I have in most instances performed arthrodesis of the ankle-joint with or without tendon fixation. Arthrodesis consists of denuding the cartilaginous surfaces of the tibia, astragalus, and the malleoli. The resulting union is fibrous and allows of some movement over a small range; this degree of movement does not increase with the lapse of time, so that stability and mobility are achieved.



FIG. 250.—Case 7. Shows the degree of stabilization achieved.

CONCLUSIONS.

1. Arthrodesis of the knee-joint should have a definite place in the surgery of infantile paralysis, provided bony union can be achieved with certainty. That this is possible in all cases at any age has been shown.

2. *Selection of Cases* should be based on the proviso that no further degree of recovery can be hoped for; the degree of permanent disability can be estimated. Cases will then fall into two groups:—

a. Completely flail limbs. In this group it is submitted that there is a clear case for the operation from two entirely different points of view. In the hospital class economy is effected by eliminating an expense which, in the majority of families, constitutes grave hardship. In all classes the tedious application of irons, constant supervision to prevent deformities and keep splints in order, disability resulting from the weight of splints, the resultant hampering of movement and limitation of activity—all these plead for a reasonable alternative such as can be provided by operation. In addition, valuable time to all concerned is saved and a useful and independent member of the community is created—a contrast to the comparatively helpless cripple demanding time and attention from others.

b. Where some muscular power exists. In this group the same arguments apply. Here, however, the advocacy of operation as against splinting depends on a careful consideration of the degree of paralysis, the particular groups of muscles in which recovery has taken place, and the ability of these muscles adequately to stabilize the limb. In this decision two main factors have to be considered in addition—namely, the weight of the patient and the weight of the necessary splint. It is clear that in this group any advocacy of operation must be postponed until an age when these factors can be assessed, and operations will only be undertaken on older children.

3. Possible Objections to the Operation.—

a. Risk. This is entirely negligible.

b. The disadvantages of a stiff limb, especially when sitting, would appear to be small in comparison with the tedious expenditure of time in putting on and taking off appliances.

c. Interference with growth. The operation can be done effectually without damaging the epiphyses. In any case the interference with the epiphyses is on so small a fraction of the whole area that it is difficult to conceive any great interference with growth. Epiphysal disease can result in lengthening, shortening, or no relative alteration, and this provides far more extensive interference. The difficulties of estimating the amount of increasing relative shortening when both legs or one only are involved make it impossible to say with certainty how much shortening is due to disease and how much to operation. In view of these considerations it is fair to regard the operation as comparatively innocuous in this respect.

d. It has been urged that the patients themselves should have the right to decide whether a permanently stiff limb is advantageous. Against this is the valid argument that a child's character and utility are formed and established respectively at an age when it cannot choose for itself. And the curtailment of the normal child's activities is a distinct disadvantage at an age when association with other children on equal terms is of great importance.

e. Finally, it may be urged that the views of parents as to the value of the procedure are not to be ignored. Both parents and older children themselves have experienced nothing but satisfaction. This satisfaction was only modified in the two early cases of massive œdema and irregular growth already reported.

I wish to express gratitude to my colleague, Mr. H. A. T. Fairbank, for his constant interest and valuable criticism, and to Dr. Bertram Shires for kindly taking the skiagrams.

ARTHRODESIS.

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(Being the Presidential Address to the Orthopædic Section of the Royal Society of Medicine, October 4, 1927.)

I HAVE chosen arthrodesis as my subject because, looking back over the changes which have gradually evolved in bone and joint surgery since 1912 or 1914, it seems to me that amongst the most marked both in this country and in America is the frequent resort to arthrodesis or the fusion of joint surfaces. In the children's hospitals in England before the war the stabilization of joints was not such a common practice as it is to-day. True, the shoulder was sometimes stabilized when the deltoid was paralysed; the spine by an Albee graft for tuberculosis; whilst arthrectomy and excision of the knee in children had been practised but had fallen rather into disrepute. In the adult the joint most often fused was the knee. The surgery of the foot, on the other hand, was largely a matter of tendon transplantation, sometimes with tendon fixation in addition. Small arthrodesing operations—e.g., that of the inner side of the mid-tarsal, the astragalo-seaphoid joint—were sometimes attempted; but this is very different from the stabilizing operations, the mid-tarsal subastragaloid arthrodesis of Dunn in this country and Hoke in America, which we use to-day. Stabilization by wire or tendon ties was practised; indeed, when Mr. Openshaw delivered his Presidential Address, he told us that he frequently wired the spinous processes of the lumbar vertebræ to gain stability of the lumbar spine after crush fractures. Stabilization of the acromioclavicular joint and even of the sternoclavicular was practised by the insertion of a tie wire.

I paid a short visit to the clinics of the Atlantic seaboard of America in May of this year, and found that their problems are much the same as ours, and that they, like us, are attempting to solve certain of them by a more frequent resort to joint stabilization. As will be referred to later, mid-tarsal subastragaloid fusion of the foot is now common practice in both countries, and so frequently is this procedure called for that we are forced to wonder how we got on without it.

When discussing arthrodesis of the hip, I shall compare the results with those obtained by reconstruction, either by Whitman's method, or the more simple attack which we now practise. But arthrodesis of the hip has a definite place in surgery. It is a modern method, and certainly was practised little, if at all, in this country in the pre-war period.

Arthrodesis is a destructive operation; the joint as a joint is destroyed, but it is in most instances preferable to amputation, which may be the only alternative, and by arthrodesis the disease may be cured or the symptoms

abolished. I would instance the mechanical arthritis following an old mal-united fracture-dislocation of the ankle. If we grant that the lapse of time since the accident and the degree of joint change prevents a reconstruction, then a stable, painless, fixed ankle is certainly preferable to amputation, and arthrodesis becomes the operation of choice.

INDICATIONS AND CONTRA-INDICATIONS.

For the purposes of discussion, it is necessary to classify, in some rough way, the indications for arthrodesis; and, as I see them, they are: (1) Pain; and (2) Loss of function, with or without deformity. The pain and loss of function result most often from:—

a. Arthritis—whether infective, toxic, or metabolic. Under this heading we include tuberculosis, and in considering the value of arthrodesing operations in the treatment of joint tuberculosis we shall, I imagine, meet with a marked divergence of opinion.

b. Trauma, particularly in fractures involving joint surfaces and fracture-dislocations in the lower limb. I shall refer particularly to ankle fractures, fractures of the os calcis, and tarsal fractures in general; but there are other minor fractures—e.g., a chip from a phalanx causing a crippling arthritis of an interphalangeal joint—which are well treated by joint fusion.

c. Paralysis, usually resulting from anterior poliomyelitis, but sometimes also from peripheral nerve injury. Those of us who were interested in this subject during the war and in the immediate post-war period will remember being called upon to arthrodesis the interphalangeal joint of the great toe following an injury to the sciatic nerve. Fixed flexion deformity of this joint was not infrequently the one symptom which distressed the patient following an imperfect recovery of the nerve. The treatment of paralytic scoliosis by spinal fusion, which is on its trial, also calls for comment.

As regards contra-indications, the one most often met with is fixation or loss of control of a neighbouring or corresponding joint. The most obvious example is the fixed knee, with a painful hip on the same side. A fixed knee with a fixed hip is a disabling deformity, and some other method of relieving the pain in the hip must be sought for.

The influence of the age of the patient as a contra-indication is of interest. I shall suggest that fusion of the knee in tuberculosis of the joint is a reasonable procedure in children, and I do not believe that age plays the part it is supposed to as a contra-indication to joint fusion.

THE QUESTION OF TUBERCULOSIS.

The whole question of the treatment of joint tuberculosis by operation must come under review. It has been the practice to treat all joint tubercle in children by conservative means, and only to resort to operation in the adult. We have believed that the results were good; we have seen the patients lying on frames and in splints in perfectly equipped country hospitals, apparently doing well—the hips held abducted, flexion deformity prevented, the knees kept in good position, and no equinus deformity in the feet. Everything is satisfactory. So far, so good. When, however, we come

to analyse a true series of end-results the picture is very different. Let me say at once that in my own experience the end-result of Pott's disease treated by conservative means is satisfactory. Satisfactory, too, is the end-result of tubercle of the small joints, e.g., dactylitis or tuberculous disease of the elbow or tarsus; but when we consider critically the true end-results of tuberculosis of the knee or of the hip we are struck by the fact that many of them are frankly bad. My colleague, George Perkins, in his Robert Jones Prize Essay of the British Orthopædic Association, analysed a series of end-results of hip tubercle. Out of 50 cases, the femoral head was diseased and altered in 41, resulting in fibrous ankylosis, with, sooner or later, adduction deformity. Old cases from any clinic, treated well or ill, show this tendency, so it would seem that we should be wise to consider whether any other method is more encouraging. In other words, when the head is affected, should the hip be arthrodesed, and if so, by what method?

It is common experience that with tubercle, certainly in the active stage, the ordinary intra-articular arthrodesis, removing the cartilage from the head and from the acetabulum, fails to give bone fusion. We are, I take it, all agreed upon this point, and the experience of the American and Continental surgeons is the same as ours. The various methods of extra-articular arthrodesis, as advocated by Hibbs, by Hass of Vienna, and later by the Boston school, do result in hip fusion, the stabilization of the joint by a bone bridge.

If the end-results of tuberculosis of the hip, treated conservatively, are poor, what are we to say of the knee? In our experience at Pyrford, the average stay of a patient with a tuberculous knee is very variable. The disease becomes quiescent with rest, and then relapse follows. It is not necessary to go into details, but we find some children do better lying in bed with a Thomas knee splint, whilst some are more satisfactory, after the acute stage is passed, in a weight-relieving caliper or patten-ended Thomas walking splint. Tuberculosis in the knee in children commences most often as synovial disease, and the bone is directly invaded at a later stage. It is rare for a bone focus to form the starting-point, although this does occur.

A common story is well illustrated by the following case report: A small boy, A. S., was under treatment from June, 1921, to September, 1922, in the country hospital. He was then discharged with the disease quiescent, wearing a caliper and attending the out-patient department at regular intervals for inspection. The knee remained apparently cured throughout 1923, 1924, and 1925, and then in 1926 there was renewed activity, and in the skiagram the bone for the first time showed evidence of involvement (*Figs. 281, 282*). This knee we arthrodesed (*Figs. 283, 284*), the patient's age being 7, and I suggest that in tuberculosis of the knee-joint in children, when the bone is affected, arthrodesis should be considered. It may be that we should go farther and not wait for bone involvement in proved tuberculosis of the knee-joint. I would not have it thought I am advocating wholesale operating in tuberculous joints in children, or that conservative treatment by rest in our country hospitals is a failure: but I do think that there is a type of joint—generally the knee or hip—which fails to respond to conservative methods. We should not be blind partisans of one form of treatment, but keep an open mind, and adopt what we believe to be the appropriate

treatment for each patient. If we do this, we shall find that in many a stage is reached when the fusion of the affected joint will be the best treatment.



FIG. 281.—Knee, proved tuberculous. No bone change yet. Compare with Fig. 282.



FIG. 282.—Same case at Fig. 281, two years later.



FIG. 283.—Antero-posterior view of case shown in Figs. 281, 282, after arthrodesis. The operation has not interfered with the growth discs.



FIG. 284.—Lateral view of the same case, after arthrodesis. The operation has not interfered with the growth discs.

In an old tuberculous hip with deformity and fibrous ankylosis, we prefer to attack the joint itself, and arthrodese in preference to doing an osteotomy, because in our experience the deformity corrected by osteotomy relapses (*Figs. 285, 286*). We have had no trouble from attacking the diseased area, with one exception, that of a girl with a fibrous ankylosis, probably the aftermath of a pyogenic and not a tuberculous arthritis; severe sepsis followed within a few days of the operation, but the wound healed



FIG. 285.—Quiescent tuberculous hip. Increasing flexion and adduction deformity. Compare with Fig. 286.



FIG. 287.—Arthrodese of hip, for arthritis, ? tuberculous, ? pyogenic. (See text.)



FIG. 286.—Same case as Fig. 285, after arthrodese.

in a month and firm bony ankylosis resulted (*Fig. 287*). We have met with sinuses after operating on knees, but these have cleared up and given no permanent trouble.

This digression on surgical tuberculosis arose from a consideration of the age of the patient as a usually

accepted contra-indication to arthrodesis, which cannot, in my opinion, be allowed to stand.

TECHNIQUE.

There are, roughly speaking, two different procedures, which are termed the intra- and extra-articular method, of attempting to obtain joint fusion; and I would at once disarm criticism by saying that the so-called extra-articular method is not truly outside the joint, and that the capsule is opened.

In the knee, in the ankle, and in most joints, it suffices to raw the bone-ends and fix them in accurate contact. There are certain technical details which I have found useful; e.g., in attempting to arthrodesis the ankle it is wise to dig well up into the cancellous bone of the tibio-fibular mortice after



FIGS. 288, 289. Bone pegs used to aid approximation, in arthrodesis of the knee.

removal of the cartilage, in order that good contact may be gained for the smaller astragalus. Good contact laterally is gained by dividing one or other malleolus and so getting closer apposition to the side of this bone. When arthrodesing the knee, accurate bone contact may be maintained by using bone pegs (Figs. 288, 289), and the patella may be imbedded across the line of the joint. It is not a question of bridging the gap, because there must be no gap. In any event, when operating for a chronic painful arthritis of the knee, it is well to remove the patella, which can serve no useful purpose, and may give rise to trouble later. I have met with one patient who, after a successful arthrodesis in which the patella was left *in situ*, complained of pain in the patello-femoral joint. But it is when we come to the hip that

the intra-articular method is liable to fail, and with tuberculosis for practical purposes always fails. Most of us can recall patients whose hip-joints would demonstrate a perfect result of arthroplasty following an operation in which we have attempted to arthrodese (*Figs. 290, 291*).



FIG. 290.—Intra-articular arthrodesis of the hip for proved tuberculosis. Two months after operation. Compare with *Fig. 291*.



FIG. 291.—Same case as *Fig. 290*, eighteen months after operation. Failure.

The extra-articular arthrodesis of the hip is a recent innovation. The procedure which most appeals to me is that devised and practised by Hibbs, of New York, who may fairly claim to be the pioneer. In April, 1926, he read a paper entitled "A Preliminary Report of Twenty Cases of Hip-joint Tuberculosis treated by an Operation devised to eliminate Motion by Fusing the Joint". From a desultory reading and reports one had the impression that he transplanted the trochanter and fixed it into the ilium above and into the rawed neck of the femur below. We tried this, but found that the trochanter was too short for the

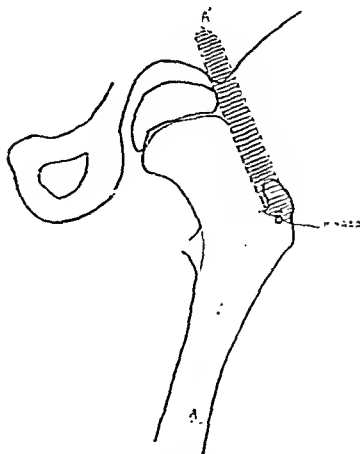


FIG. 292.—Diagram of Hibbs's extra-articular arthrodesis of the hip.

purpose. The actual method which he practises (*Fig. 292*), and which most certainly succeeds in fusing the hip, is the transplantation of the anterior two-thirds of the trochanter, together with about two inches of the cortical

bone of the femoral shaft. This bone-graft is pedunculated and left with the upper part of the trochanter attached by periosteum, and the free end—



FIG. 293.—Proved tuberculosis of the right hip, before extra-articular arthrodesis. Compare with Fig. 294.

that taken from the femoral shaft—is laid along the superior surface of the neck of the femur bared for its reception, and firmly wedged into a



FIG. 294.—Same case as Fig. 293, after extra-articular arthrodesis.

groove cut in the ilium above the acetabular rim. Slight abduction jams the bone-graft firmly into position (Figs. 293, 294).

I saw Allison in Boston arthrodes a hip by the extra-articular method, using a free graft taken from the tibia, and he kindly sent me prints of the skiagrams, which illustrate the method he is using (*Figs. 295, 296*). The big tibial graft is supported by small osteoperiosteal or sliver grafts as advocated by the French school. A graft may be turned down from the outer table of the ilium along the neck, to reach the trochanter; but the femoral or tibial graft is as convenient, and is stronger mechanically.

I saw the operation I have described performed by von Laekum in Hibbs' clinic, and Hibbs showed me a large number of patients in his country hospital whose hips he had fused by this method. The hips were firmly fused by bone. X-ray evidence and clinical examination bore this out, and I am convinced that in his hands, at least, the problem of arthrodesing the hip-joint for tuberculous is solved. Whatever views we may hold as to whether the operation is frequently called for or not, we shall agree that there are occasions when it is necessary to fix the hip.



FIG. 295.—Tuberculous hip, before extra-articular arthrodesis. Dr. Allison's case. Compare with Fig. 296.



FIG. 296.—Same case as Fig. 295, after extra-articular arthrodesis.

In an arthrodesis Hibbs lays great stress on the careful saving of the periosteum, and relies on this structure to form new bone. He peels it off with care, taking perhaps the outer layer of compact bone with it if it does not strip easily. The arthrodesis or fusion of the spine which he practises leaves, when the dissection is complete, a series of spinous processes and laminae, cleared of periosteum, which periosteum forms a practically unbroken sheet lining

the muscles and soft parts which have been retracted.

Bone fusion is proved by clinical examination and by skiagram, and in those patients who have died of intercurrent disease the specimens show the firm bone arch posteriorly, and the fused joints between the articular processes.

PAIN AND DISABILITY FOLLOWING TRAUMA.

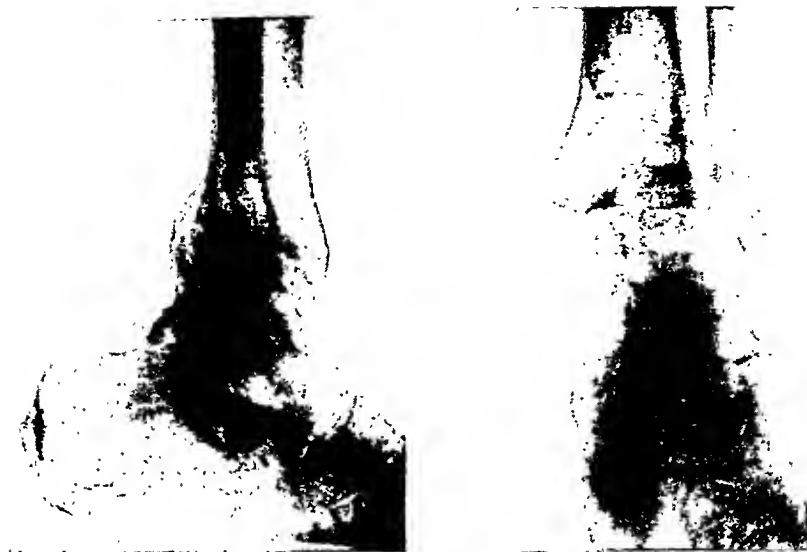
The use of arthrodesis in the treatment of painful joints following fractures or other trauma needs to be emphasized. I am myself convinced that arthrodesis of the ankle is the best procedure to adopt in any old mal-united ankle-joint fracture, when there is evidence of traumatic or mechanical arthritis (*Figs. 297-300*). In a series of patients I have done this operation and the results are good. Pain is relieved, and the function with a fixed ankle, in the right-angled or just above the right-angled position, is excellent. Many of these patients can walk any reasonable distance, and would seem no worse off than before the accident.

The severe disability following a fracture of the os calcis is generally admitted. Treatment by attempted reduction followed by fixation in plaster and relief from weight-bearing for many months has failed to relieve the pain. This is not surprising if, as we believe, the pain is largely due to a mechanical arthritis of the subastragaloid joint. Wilson, of Boston, read a paper in the recent discussion on fractures held under the auspices of the American Medical Association in Washington, advocating immediate arthrodesis of the subastragaloid joint for fracture of the os calcis. He produced statistics of his end-results, proving that his patients of the industrial class got back to full work in a reasonably short space of time, and the results were immeasurably better than by any other treatment. We have done this operation with good result, though only in the late stage: but should not hesitate to carry it out in any recent os calcis fracture involving the joint—and the joint is involved in all crush fractures.

Arthrodesis of the spine—spinal fusion—is practised in America as the treatment for crush fractures of the vertebrae. Osgood and the Boston school are confident that the results are better, and more quickly obtained, than by conservative treatment. In that country, too, where low backache is so common, arthrodesis of the lumbosacral joint, and, with some, arthrodesis of the sacro-iliac joint, are becoming popular. Smith-Petersen's approach and technique in operating on the latter joint would seem to ensure fusion of the joint.

In spinal fusion the operation devised by Hibbs is the operation of choice. Anyone who has watched Hibbs arthrodesis a spine must, I think, feel, as I did, that the operation is bound to result in solid bony ankylosis. Technically the operation is more difficult than that of Albee, and takes considerably longer, but to my mind the end justifies the means. Three months' rest in bed in a light back-brace follows, after which the patient is allowed up without support.

The size and importance of a joint are not necessarily the only factors which govern our decision. I saw this year a patient with a chip fracture of the phalanx of a ring finger, with mechanical arthritis of the interphalangeal joint. He had been prevented from using the hand by pain for some nine months. Fixation by strapping and a splint had failed to relieve the arthritis. A simple operation, such as most of us use for a hammer-toe, gave him a useful and painless finger which enabled him to hold a golf club in comfort and use the hand freely. The terminal interphalangeal joint was fused in slight flexion, and there was no disability.



FIGS. 297, 298.—Mal-united Pott's fracture, before arthrodesis of the ankle.
Lateral and antero-posterior views. Compare with Figs. 299, 300.



FIGS. 299, 300.—The same case as Figs. 297, 298, after arthrodesis of the ankle.

I have never myself seen the necessity to fix either end of the clavicle for recurrent dislocation of the acromio- or sterno-clavicular joints. The former is a common, the latter an uncommon, accident. In either case the functional utility of the limb is little if at all affected, and is soon recovered with appropriate physical methods.

When considering the part arthrodesis is to play in the treatment of chronic painful arthritis of the hip, it must be emphasized that severe pain, with or without crippling deformity, is the symptom which makes one advise operation. Imagine symptomatic treatment has been tried and has failed, and the question arises—Can operation on the hip offer hope of relief from

the pain, and, if so, what operative attack is best suited to the needs of the particular patient and the particular hip?

We have attempted to arthrodesis the hip-joints in about thirty patients. Pain can be relieved, although the hip does not always arthrodesis, for the operation may, and frequently does, result in a short fibrous ankylosis. The method is useful, but there are certain considerations which have made us try out the operation of reconstruction, leaving a movable joint. First, the after-treatment of arthrodesis of the hip is necessarily a prolonged fixation in plaster, and in most hands the spica is applied on the table. Therefore operation is prolonged, and after-fixation very much prolonged. The first is perhaps a small point, the second of more practical importance, because these patients are usually past middle life and do not tolerate prolonged fixation as well as younger people.

Then, when the hip is fixed, there is

additional strain thrown on the lumbar spine, and it is small consolation to the patient if his painful hip is cured at the expense of a painful lumbar spine and chronic low backache.

Again, both hips are sometimes affected, or a hip and knee on the same side. Arthrodesis of the hip is then out of the question.

I feel, then, that reconstruction of the hip, although still perhaps in the experimental stage, is well worth a trial. We used to practise the operation devised by Whitman (Figs. 301, 302), but we now try what is a more simple procedure (Fig. 303), and the results are fairly good. The operation is simple, and there is little shock. The after-treatment consists in moderate fixation for a month, and then the patient is allowed up. We insist on frequent manipulation in the direction of extension and abduction, just as



FIG. 301.—Whitman's reconstruction of the hip for chronic arthritis.

Whitman taught was the correct after-treatment following his reconstruction of the joint.

The treatment of paralytic deformities by joint fusion dates back many years, but the great change which has taken place is in the treatment of the paralytic deformities of the foot. We owe to Dunn in this country the modern operation of mid-tarsal subastragaloid arthrodesis—and the American surgeons favour a somewhat similar operation, devised independently about the same time by Hoke. Dunn's method of stabilization of the foot, the employment of which is by no means confined to paralytic deformity, has solved many problems which were before incapable of solution. Dunn's operation has stood the test of time and gives a good functional foot. In many paralytic deformities of the foot it must be combined with tendon transplantation, if we are to avoid recurrence of deformity by unbalanced muscular action.

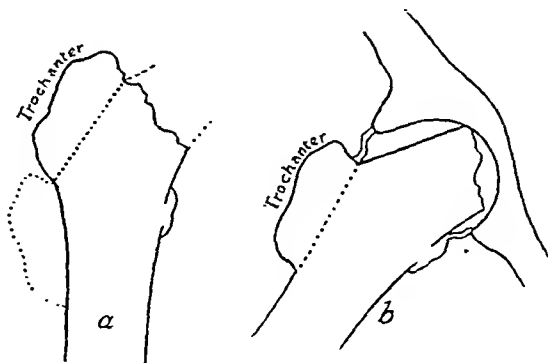


FIG. 302.—Diagram of Whitman's reconstruction operation on the hip-joint. *a*, Showing complete loss of femoral neck after fracture. *b*, Shows reconstructed neck and area obtained from removal and transplantation of trochanter. (From '*Annals of Surgery*.')

Arthrodesis of the shoulder, less often called for, yields good results in carefully selected cases.

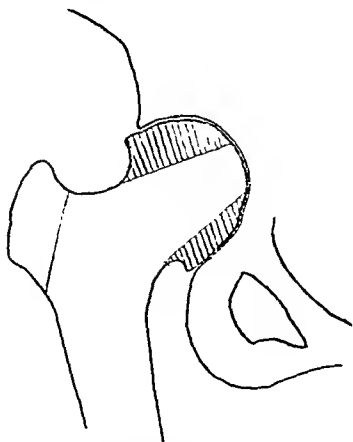


FIG. 303.—Diagram of the 'remodelling of the head' operation for chronic arthritis of the hip-joint.

I have attempted to call attention to the important position which arthrodesis occupies in modern orthopaedic surgery, and to suggest that its sphere of usefulness is wider than we have believed in the past. Whilst its uses in the treatment of surgical tuberculosis during the active stage are to be carefully weighed and considered, I feel that in certain directions, notably in the treatment of mechanical arthritis, we can with advantage practise it more often. May I say again that for mal-united Pott's fractures and for fractures of the os calcis I think that arthrodesis should be resorted to much more frequently than has been our custom. Finally, for many conditions we

have here a method which we can employ with the certainty of success in attempting to solve that all-important problem—the relief of pain.

TREATMENT OF ANKLE AND LEG FRACTURES BY THE 'DELBET' AMBULATORY PLASTER SPLINT.

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THE following ambulatory treatment is based on that elaborated and described by Professor Pierre Delbet, of the Hôpital Cochin, Paris. This method of treatment was introduced to the writer in January, 1923 (when House Surgeon at the Royal Northern Hospital, London), by Mr. Gwynne Williams, under whose direction he was permitted to treat his first cases.

The method differs from others in the following particulars:—

1. The patient is made to walk within one, two, or at most three weeks from the date of accident, bearing full weight on the injured limb.
2. From commencement of walking he actively moves ankle- and knee-joints, thus enjoying the most efficient form of massage—namely, natural function; this prevents that long-persisting stiffness and swelling of the foot which so loudly advertise the limitations of the usual methods of treatment.
3. He is able to return to ordinary forms of work in from four to six weeks after the date of accident if he wishes to do so, walking in his splint, without being encumbered by the use of crutches or walking-sticks.
4. From eight to ten weeks after the date of the accident the plaster splint is removed and all form of treatment ceases, except that the boot is wedged on the inner side.

The method has been found successful in the following types of cases:—

Ankle Fractures.—(a) Abduction and adduction fractures with one or both malleoli detached, and with lateral displacement of the astragalus. (b) Malleolar fractures with anterior or posterior displacement of the astragalus, and with a detached wedge off the front or back of the tibia, the fragment not being much displaced.

Leg Fractures.—

1. *Closed Fractures.*—(a) Fracture of the tibia alone. (b) The 'torsion' variety, an oblique or spiral fracture in the lower third of the tibia and upper end of the fibula, when there is not much over-riding or angulation of the fragments. In these cases the bones frequently lie in close apposition and parallel with each other, while shortening does not exceed a quarter to half an inch. (c) Transverse fracture of both bones in the lower half, with or without comminution, as occurs when a cart-wheel passes over the leg above the ankle. To avoid the disabling deformity of posterior bowing, one should deliberately aim at producing a slight degree of anterior angulation by placing a firm wad (bandage roll) under the plaster before it sets, opposite the line of fracture. (d) Some cases of fracture in the upper half of the leg; in these the Delbet plaster as described below is useless, but at the suggestion

of Mr. Gwynne Williams the writer has extended the plaster up to the mid



FIG. 304.

FIGS. 304, 305.—To show application of extended Delbet splint.

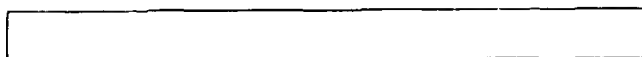
thigh, and in the two cases in which this was tried the results were very satisfactory (*see Figs. 304, 305*).

2. *Open Fractures*.—When the wound has healed, provided that good alinement of the fragments has been maintained.

THE ‘DEL BET’ PLASTER.

The plaster is applied immediately after manipulation has been carried out as described below, while the patient is still under the anæsthetic. The splint consists of four pieces, made of book

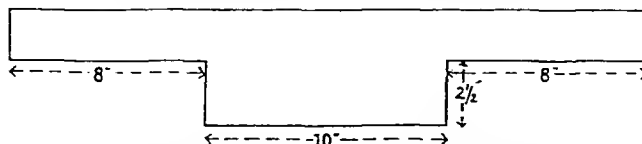
FIG. 305.



Upper band : 26 by 2 in. ; made of 16 layers.



Two side bands : each 26 by 3½ in. ; of 24 layers.



Lower band : 26 by 2 in., with heel-piece ; of 16 layers.

FIG. 306.—Diagram to show the composition of the Delbet splint.

muslin (mesh 42), cut to pattern as shown in *Fig. 306*. The measurements are varied as required for adaptation to small or large legs.

A board is placed under the leg to make a firm even surface. The foot being held by the toes in an inverted position by an assistant, the leg is marked as follows: (1) A transverse line is drawn across the front and sides of the leg at a level just below the prominence of the tibial tubercle. (2) A line is drawn longitudinally up each side of the leg from the anterior border of the corresponding malleolus to the transverse line above. The transverse line marks the upper limit of the upper band when wound round the leg, and the longitudinal lines mark the anterior border of each side band when applied; thus the lateral band will lie on a more posterior plane than will the mesial band (*Fig. 307*). If the leg is very hairy it may be shaved; this is not essential. The leg and foot are well greased with vaseline. Strips of

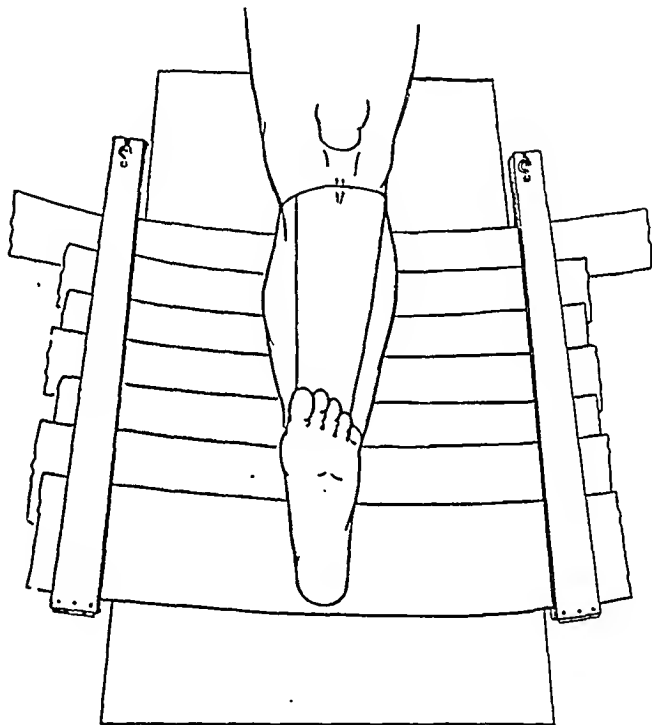


FIG. 307.

calico bandage (4-in.), cut out with a curve and arranged in imbricated fashion, have been previously prepared and secured in two wooden clamps (*Fig. 307*). Later they will be used to bind the wet plaster bandages tightly on the leg and so ensure a close fit. The clamped strips are now laid flat on the board under the leg, to extend from heel to knee (*Fig. 307*).

Mixing the Plaster.—One pint each of plaster-of-Paris and of cold water are usually sufficient; in warm weather 24 oz. of water are used. The plaster should be purchased in sealed tins, the lid being resealed by adhesive strapping after use, to keep the contents air-tight (the writer uses the plaster supplied in 7-lb. tins by Messrs. Allen & Hanburys). It is not advisable to use agents for hastening the setting of the plaster, such as warm water or

the addition of salt or alum; this introduces a variable factor which is not only unnecessary but may cause setting before the operator has time nicely to adjust the bandages. A large enamel basin is used for mixing; the plaster is quickly sprinkled into the water, and stirring is not begun until all the plaster has been put in and is completely wetted. This ensures a thin, even, creamy mixture without lumps. The bandages are all put into the mixture together, each piece in succession being thoroughly soaked.

Application of the Plaster Bandages (*Figs. 308, 309*).—One assistant is needed, who stands at the opposite side of the bed, and should be conversant with the method.

1. The top band is laid under the leg, its upper border coinciding with the marked transverse line, with protruding ends of equal length.

2. The lower band is then laid transversely in position, so that the lower border of the central heel-piece lies just short of the flat plantar surface of the heel, and with the heel placed excentric, allowing more turn-up on the inner side of the ankle, where the malleolus reaches farther forward than on the outer side.

3. Each side band is now applied as follows, the one on the assistant's side of the leg being placed first (*Fig. 309*): The band is placed so that the knee end reaches the transverse line on the leg, and the anterior (uppermost) border coincides with the marked longitudinal line. The assistant presses the knee end against the leg with his thumb; the band is now doubled back on itself below, the doubled portion extending about three-quarters of the way up the leg again, and the folded border reaches downwards to just short of the plantar heel surface. The assistant holds the lower end to the leg just above the ankle with the other thumb; closing his grip above and below he now rotates the leg towards the operator, while the latter adapts the posterior part of the band to the leg. The other side band is applied in a similar manner, the assistant holding it to the leg by closing the grip of each hand, and again rotating for posterior adaptation.

4. The upper band is then bound tightly round the top of the leg outside the side bands; this is best effected by the assistant maintaining a pull on one end while the other end is pulled over and across and tucked

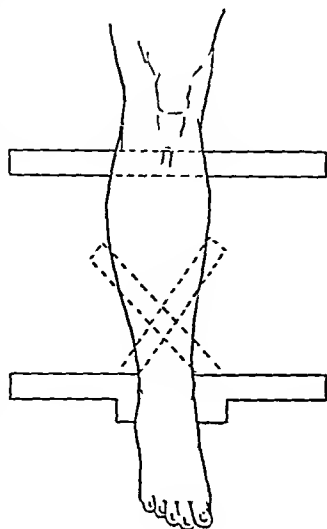


FIG. 308.

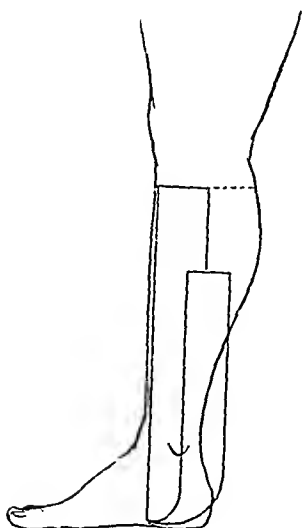


FIG. 309.

in flat behind, the side bands still being held in position by the free hand of each worker.

5. The lower band is applied in the following manner: Each lower corner of the heel-piece, and the corresponding point of its upper border, is grasped between finger and thumb of both the operator and his assistant on either side. The hands are then brought forward, and thus the heel and malleoli are encased in the plaster. The assistant then stands at the foot of the bed, or preferably kneels, and with hands placed along each side of the heel and ankle presses firmly on the plaster, at the same time inverting the heel and external malleolus. Meanwhile the operator crosses the two ends of the lower band over the leg, leaving room for play of the tibialis anticus tendon below the crossing when the patient commences walking. A little plaster cream is then rubbed over the various joins.

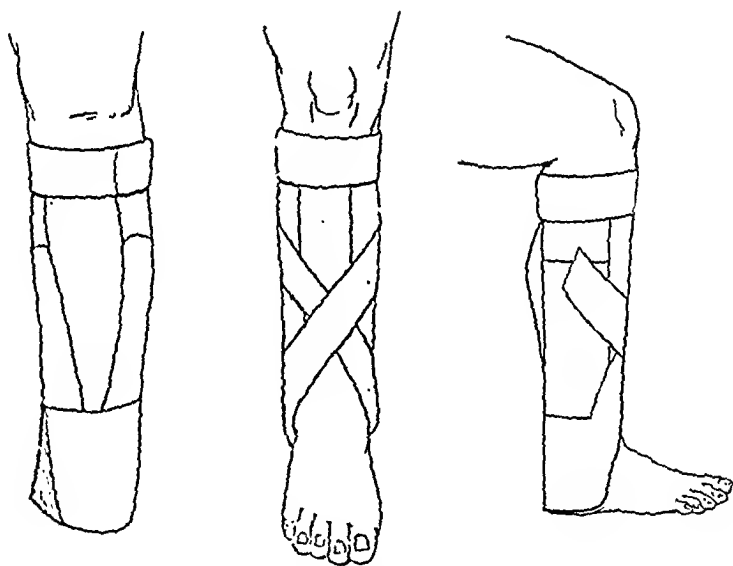


FIG. 310.—Showing the leg after removal of the calico.

6. Lastly, the clamps are opened and the calico strips (*Fig. 307*) bound over the plaster in 'many-tail' fashion: this should be done tightly, beginning below and on the inner side, as the inner band has a tendency to slip backwards. The whole is 'tied' by knotting the uppermost strip over the interval between the two bones, thus avoiding a pressure sore later under the knot. The foot and ankle are again compressed between the two hands and inverted as before, and held thus until the plaster sets hard, which will be in about ten minutes from the time of mixing.

Sandbags are stacked on either side of the leg, interlocked by a roller towel, the weight preventing the patient from moving the limb while coming round from the anæsthetic. The leg is left so for two hours, after which it is placed on a pillow. The calico strips are removed on the following day and the plaster is dated. (*Fig. 310.*)

It must be noted that no moulding should be done after the plaster

has begun to set, as this causes it to crack. When the plaster is quite dry and of stony hardness, which will be after one or two days, the ankle is X-rayed again, and if the displacement of the astragalus has not been *completely* reduced the plaster is removed, another general anæsthetic administered, and the persisting displacement corrected.

The above description may seem tedious and superfluous in detail, but to obtain success by this method of treatment a solid accurately-fitting plaster is essential; one must have a methodical procedure to work on, and the laborious experience of over two hundred 'efforts' has suggested to the writer little manœuvres which both save time and make for success.

Successive plasters are put on the same case as required in exactly the same way, though the anæsthetic and manipulation are not repeated unless the first attempt at reduction has failed. The indication for renewal is looseness of the plaster owing to the gradual subsidence of œdema; the average number of plasters for the whole period of treatment in cases of ankle fracture is two or three. All form of treatment ceases in from eight to ten weeks from the date of accident, when the last plaster is removed, the patient at this stage having been walking for the several preceding weeks without stick or aid of any kind.

It will be noticed that the plaster is applied directly on the skin surface; this leads to no ill-effects *per se*, and the absence of any form of lining material makes easier the early detection of the presence and extent of pressure sores later. However, if abrasions or blisters are present, a small piece of double thickness of gauze wetted with flavine is placed over them before the plaster is applied.

ANKLE FRACTURES.

The following is a detailed account of the method of treatment used by the writer in cases of recent ankle fracture :—

1. The patient is put to bed with the leg—which is temporarily controlled in a box splint—raised high on pillows, so that the ankle is higher than the knee, and the knee higher than the hip; this partially reduces the swelling and alleviates pain. A flavine dressing for abrasions and blisters, and a cooling lotion, are applied if necessary.

2. The ankle is X-rayed as early as possible, the splint being removed for the purpose: two views are taken. It is well to emphasize that a 'dead true' antero-posterior view is essential, especially in those cases in which there is only a slight lateral displacement or eversion of the astragalus, as such slight displacements tend to be completely missed even when shown by the skiagram, and so remain uncorrected with a resulting future disability.

3. A general anæsthetic is given in every case, and complete relaxation obtained where the skiagram shows any displacement, unless the general condition of the patient forbids. This may seem unnecessary in cases presenting only slight displacement, but in the experience of the writer it is just these cases which offer most difficulty in reduction. Adduction fractures are more easily reduced, and the procedure can often be accomplished without any anæsthetic. It is interesting to note that in them no ligaments are ruptured

(other than the joint capsule). However, it is safer to adopt the rule that a general anæsthetic should be given in all cases.

Reduction.—It is not necessary to flex the knee in order to reduce posterior dislocations if full anæsthesia is obtained, the weight of the limb alone being almost sufficient to effect reduction if the foot is held up by the heel.

To correct lateral displacement, in the case of the right ankle, the leg is grasped by the left hand just above the ankle, preferably with the 'heel' of the hand and ball of the thumb pressed against the mesial border of the tibia; the heel of the foot is grasped in the right hand so that the 'heel' of the hand is pressed over the external malleolus (*Fig. 311*); firm steady pressure is now exerted in opposite directions by the two hands, the right dorsiflexing at the ankle-joint while maintaining inward pressure over the external malleolus. In the case of the left ankle the 'holds' are reversed. Rough handling, as by bruising the tissues in a vicious finger-grip, is to be avoided; this only increases the injury to the soft tissues, with resulting increase in swelling which holds the plaster splint farther off the bones, lessening its retentive effect.

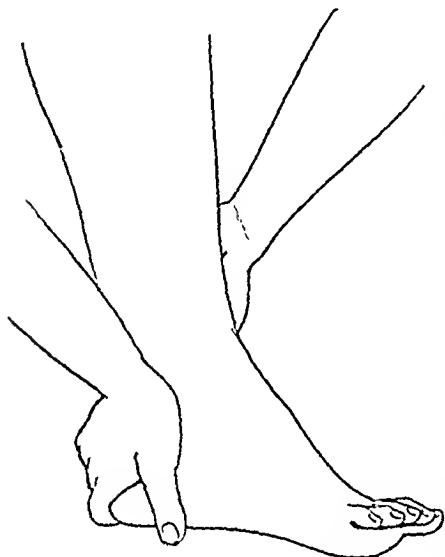


FIG. 311.—To illustrate the correction of lateral displacement.

So important is it to obtain complete replacement of the outward astragalus that one may adopt the working rule that it is impossible to over-correct it; this is not strictly true, but the point is stressed because on several occasions after he had used force almost amounting to violence the writer has been disappointed to find a persisting slight outward displacement, as shown by X rays. Also it must be remembered that the clinical appearance of a swollen

ankle is no certain guide to the position of the underlying joint bones; radiography offers the only proof.

When should reduction be effected? Generally speaking within forty-eight hours from the time of accident if possible; greater hurry is not essential, although often desirable. In cases, however, where swelling and blebs are very marked, and displacement is not extreme with skin stretched tight over the fragments, it is an advantage to leave the patient with his foot well raised and the blisters dressed for three or even four days before reducing, thus allowing the swelling to subside partially before putting the leg and foot in plaster as described above.

Pressure Sores.—Sores caused by chafing of the plaster do occur, the common sites being at the anterior corners of the lateral bands and at the edges of the upper band. The sores are generally quite superficial, and the only treatment required is to cut away the offending edge of plaster, and make the patient rest more with the leg elevated on a chair. Occasionally deeper

sores occur which necessitate temporary confinement to bed and free paring of the plaster to allow for dressing; such sores may delay walking for one or even two weeks, but are certainly not of sufficient gravity or of such frequent occurrence as to constitute a serious objection to the method, compared with its overwhelming advantages to the patient. An avoidable pressure sore is one due to pressure of the knot tied in the uppermost calico strip causing an indentation in the plaster if the knot is placed over the front of the tibia: it should be over the interval between the two bones.

Walking.—Professor Delbet,¹ in his description of this method, advocated walking within a day or two of the application of the plaster. While the writer fully agrees with such early walking in the slighter cases not showing any displacement, he thinks there is a risk of redisplacement occurring if weight-bearing is allowed in the more severe cases at such an early date, as the large amount of oedema around the ankle so often present in these cases holds the plaster off the external malleolus, thereby permitting movement of the latter under stress; for the acting principle of the plaster is that it prevents lateral movement of the parts controlled by it, and not that it transmits the body weight from the malleoli to the upper end of the tibia, as was claimed by Professor Delbet. Therefore, at the commencement of treatment the first plaster is used merely as a retentive splint, and is renewed when swelling has subsided sufficiently to make it loose, usually between the first and second weeks. It may be mentioned here that others who have adopted this method put the foot and leg up in a complete plaster cast after manipulation; this is removed in about two weeks and replaced by a Delbet plaster. There is no essential difference between the two procedures, each splint being equally retentive if properly applied.

When the second Delbet plaster is thoroughly dry and hard the patient is made to walk. This is sometimes a laborious task for the surgeon, especially in the 'compensation' or 'dole' type of patient, and requires much patience and firmness; but it is often surprising to find how some patients with more spirit will walk tolerably well from the start. At the first lesson it will be well for the surgeon to ignore completely the protestations of pain and inability to stand made by a 'flabby' patient; the latter must be convinced that his injured limb can bear his weight by being made to stand firmly on it from the outset.

The patient is first allowed to swing his legs over the side of the bed for a few minutes, after which he is made to stand upright, with feet a little apart and toes pointing directly forwards facing the surgeon, who holds his hands; he now bends both knees several times while keeping his heels on the ground, and so actively dorsiflexes the ankle-joint from the very beginning of treatment. The patient then walks, taking small steps, and bringing each foot in front of the other at each step, his only support being 'holding hands'.

After he has been thoroughly convinced that he *can* walk, he is given sticks with rubber ferrules and encouraged to get about as much as possible. The objection to allowing a patient to walk with crutches is that he avoids putting any weight on the injured limb and does not move his ankle-joint, thereby missing the whole principle of the treatment. The most accurate estimate of progress is by making him walk 'holding hands', by which

means he must bear his own weight. Enthusiastic patients will find that they can dispense with both sticks in from one to two weeks. In the early stage walking increases the swelling, which may lead to pressure sores from the skin bulging over the plaster edges; this can be relieved by making the patient sit with the leg raised on a high chair whenever he is not actually walking.

Return to work is permitted, in the splint, as soon as the patient can walk with confidence; this period will vary with the mentality of the individual and with his particular kind of work; an occupation which entails ladder-climbing will be obviously unsuitable. The writer has had patients who have, in their plaster, knelt to do housework, stood all day at the wash-tub, walked over seven miles (a leg fracture), while many have been able to get about on buses and trams, thus resuming an active life in from three to four weeks after the injury.

Results.—Manipulation being the method of choice in the great majority of cases of ankle fracture, and retention by means of plaster-of-Paris being generally conceded the most reliable form of splinting, it remains to determine which method can get the patient back at work and provide him with permanent good function in the shortest space of time. The writer's series of cases is too small to justify any claim regarding his results as compared with those achieved by other methods; but a brief survey of a few collected facts will, he hopes, warrant the conclusion that the Delbet plaster offers promise of a definite advance in the treatment of this difficult type of fracture.

Of the 24 cases of recent ankle fractures in this series there was no apparent displacement of the astragalus in 5. Of the remaining 19 cases a general anæsthetic was contra-indicated in 3. The following figures are averages taken over the 24 cases: (1) Date of commencement of walking, from day of accident, 14 days. (2) Date of removal of last plaster, and cessation of all treatment, from day of accident, 52.2 days. (3) Date after accident on which patient dispensed with use of a stick (ascertained in 21 cases only), 35 days.

Statistics in fracture cases are a doubtful source of information, based as they frequently are on a circularized questionnaire addressed to the patients. It is particularly difficult to convince a work-shy patient that he is fit to resume work, when a weekly visit to his panel doctor, on a plea of persistent pain or swelling, will provide him with the desired certificate of disability. One can only eliminate any tangible cause by X-ray and clinical examination, and then compare him with others who have suffered a similar or a more severe injury, but whose interests have been best served by an early return to their occupation. Therefore it would seem of much more value to quote X-ray and clinical findings at the end of the period of treatment, and again at a more remote date.

Another confusing factor to be considered when working out a new method of treatment is that failures during the experimental stage may be due to ignorance on the part of the worker, or to his method. In this connection the writer may state that of his own failures—5 out of 24 cases treated with the Delbet plaster—incomplete reduction at the outset (although a general anæsthetic was considered inadvisable in 3) was responsible for 4. The fifth case is an instance of failure of the method, the only apparent

excuse being that the patient, a woman of rather heavy build, was permitted to walk on the sixth day, when œdema around the ankle was still marked.

It will be more instructive and convincing to present a few cases, with X-ray plates and full details of treatment, as showing some results that have been obtained by this method.

CASE REPORTS.

Case 1.—Severe abduction fracture of the ankle, Dupuytren type (*Figs. 312–315*).

S., age 22, picture framer. On *Jan. 17, 1926*, had a toboggan accident, fracturing the right ankle.



FIG. 312.
Case 1. Jan. 18, 1926.

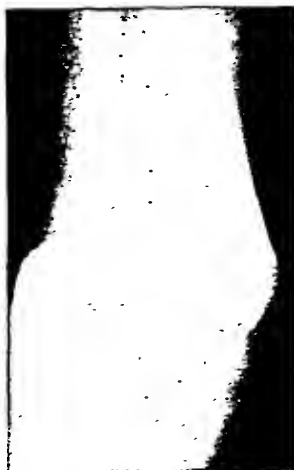


FIG. 313.
Case 1. Jan. 18, 1926.



FIG. 314.
Case 1. July 13, 1927.

Jan. 18: Marked swelling and deformity of the right ankle, large blisters, lower end of tibial shaft almost through skin. Manipulation under general anæsthetic; 1st Delbet plaster.

Jan. 25: 2nd Delbet (did not set).

Jan. 26: 3rd Delbet.

Feb. 1: Patient walked.

Feb. 2: 4th Delbet; Dispensed with sticks.

Feb. 6: Walking almost naturally.

Feb. 14: Plaster removed; two deep pressure sores, one over internal malleolus; put to bed.

Feb. 24: To sit up with leg raised.

Mar. 3: 5th Delbet.

Mar. 5: Walks with barely perceptible limping.

Mar. 6: Discharged.

Mar. 24: Plaster removed. All treatment ceased, i.e., 66 days after accident. Has been at work since discharge and leading normally active life, riding on buses and trams; no limping during past week. All movements of ankle free, including full dorsiflexion. Skiagram showed good position.



FIG. 315.
Case 1. July 14, 1927.

LATE RESULT.—July, 1927: Has had no disability whatever since last seen. No deformity, pain, or swelling. All movements of foot and ankle equal to those of the other side. Skiagram.

Case 2.—Abduction fracture of the ankle with complete posterior dislocation (Figs. 316-318).

P., age 65, retired station-master. On June 29, 1923, was knocked down by motor van, the wheel of which passed over the left ankle. Manipulation was done under a general anæsthetic, and a Delbet plaster applied.

July 5: Plaster removed owing to pressure sore over internal malleolus.

July 13: 2nd Delbet plaster.

July 21: Has been walking several days. Discharged.

July 30: 3rd Delbet plaster.

Aug. 29: Plaster removed. All treatment ceased, i.e., 61 days after accident. Walks well. On arrival home walked upstairs alone, without a stick. Did not require stick after this date, although used one when out because he was nervous.

LATE RESULT.—Seen in August, 1927, patient stated that from one month after removal of plaster he had no limp, and the left ankle was as free as before the accident. Has suffered no disability in any way since. Examination: No limp, very slight eversion

left foot. All movements of foot and ankle equal to those of the other side, including dorsiflexion to beyond a right angle. Skiagram:



FIG. 316.—Case 2. June 29, 1923.

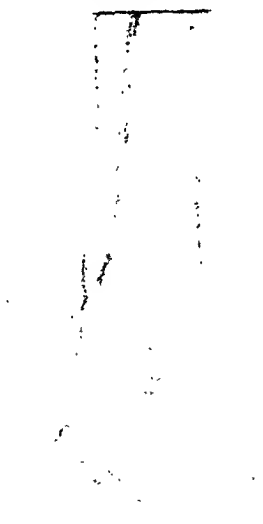


FIG. 317.
Case 2. Aug. 11, 1927.



FIG. 318.
Case 2. Aug. 11, 1927.

Case 4.—Abduction fracture of the ankle with outward and backward displacement, posterior wedge off tibia (*Figs. 319-322*).

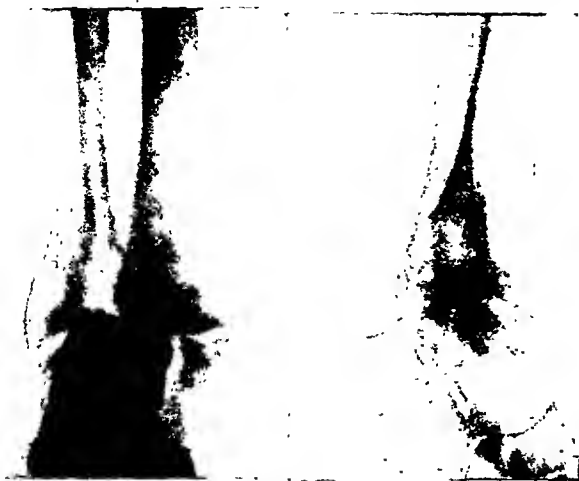


FIG. 319.
Case 4. Sept. 9, 1926.

FIG. 320.
Case 4. Sept. 9, 1926.



FIG. 321.
Case 4. July 19, 1927.

Mrs. G., age 43, housewife. On *Sept. 9, 1926*, tripped when getting off tram, fracturing right ankle.

Sept. 10: Manipulation under general anæsthetic. Complete plaster cast.

Sept. 24: Plaster removed: skiagram shows persistent slight outward displacement. Manipulation under general anæsthetic. 1st Delbet plaster.

Sept. 29: 2nd Delbet.

Oct. 1: Walked well.

Oct. 2: Walked without sticks.

Oct. 12: 3rd Delbet.

Oct. 28: Plaster removed. All treatment ceased, i.e., 49 days after accident. Skiagram.

Nov. 4: Walks with slight limp, rather nervous. No deformity, some œdema. All movements of right foot and ankle equal to those of the left side, but dorsiflexion only to a right angle.

LATE RESULT.—In July, 1927, there was no disability in any way, no pain, no swelling, no deformity.

LEG FRACTURES.

Contra-indications.—(1) Fractures involving the upper joint surface of the tibia. (2) When there is marked tilting of pointed fragments which would lead one to suppose that the periosteum has been 'button-holed' by one of them. some form of continuous traction on the lower fragment is essential; this may be effected by a metal pin driven through the os calcis, or by an adhesive apparatus on the foot, according to the temperament of the surgeon. In the writer's experience, temporary traction under a general anæsthetic,



FIG. 322.
Case 4. July 19, 1927.

even by hanging a 40-lb. weight on the foot for half an hour, has not been successful in reducing such displacements. If used in the later stage of treatment in these cases, the Delbet plaster will enable the patient to get about at an early date and so considerably shorten convalescence.

It is common knowledge that weight-bearing through a fractured limb stimulates the early formation of firm callus; this fact is well illustrated in a small series of 14 cases of leg fracture: in these the average period of treatment was only 62 days, after which no support was necessary, other than the use of a stick in some cases. The average age of these patients was 46 years, and shortening did not exceed $\frac{3}{8}$ in., except in one case which is now recognized as being an unsuitable type of fracture for this form of treatment in the early stage; this patient had $\frac{7}{8}$ in. shortening.

That absolute anatomical reposition of the fragments is not essential to the recovery of perfect function is borne out by experience (*see Case 9*). Provided that good alignment is restored, through which weight is transmitted vertically from the joint above to the one below the fracture, no disability need be feared.

The Delbet plaster is applied in cases of leg fracture in exactly the same way as has been described above; the method described by Professor Delbet of obtaining traction during the application of the plaster by attaching a heavy weight to a tape 'stirrup' sewn around the ankle, has not proved very effective in the writer's hands.

When angulation or some other form of displacement makes manipulation necessary, a general anaesthetic is given and the plaster put on after the deformity has been corrected.

CASE REPORTS.

Case 7.—Leg fracture torsion variety (Figs. 323, 324).

T., age 54, salesman. On April 10, 1923, fell down steps, fracture right leg, lower third tibia, upper fourth fibula. No displacement.

April 12: 1st Delbet applied, no anaesthetic.

April 15: Walking with sticks.

April 16: 2nd Delbet plaster.

April 21: Walking better.

April 26: 3rd Delbet plaster.

April 28: Patient discharged. Walking.

June 13: Plaster removed. Walks well; $\frac{1}{4}$ -inch shortening.



FIG. 323.
Case 7. April 10, 1923.



FIG. 324.
Case 7. Aug. 16, 1923.

LATE RESULT.—Seen in August, 1927, patient had no limp, no deformity, $\frac{1}{4}$ -in. shortening. Natural gait. Has suffered no disability. States that he used a stick for one month after plaster was removed. Got job as 'traveller' at end of July, 1923, and was walking about from 9 a.m. till 5 p.m. daily.

Case 9.—Leg fracture. Anatomical reposition not effected: no functional disability as a result (Figs. 325-328).

Mrs. M., age 42, housewife. On July 24, 1926, slipped on ground; closed fracture right leg, lower half tibia, lower fourth fibula. Forward displacement lower fragment, $1\frac{1}{4}$ in. shortening. Two attempts to reduce displacement by hanging a 30-lb. weight on foot for half an hour failed (without anæsthetic).

Aug. 6: Continuous extension made on the lower fragment by attaching a 9-lb. weight to a plaster-of-Paris sock.

Aug. 10: Weight increased to 12 lb.

Aug. 19: Plaster sock removed, deep pressure sores over dorsum, ankle, and on heel: $\frac{1}{4}$ in. shortening. Delbet plaster applied.

Aug. 21: Walked a little.

Aug. 25: Can walk without sticks.

Sept. 9: Plaster removed on account of heel sore.

Dec. 21: Heel sore not yet healed. Up but not walking. Dorsiflexion at ankle limited.

Jan. 6, 1927: Sore healed. Cannot keep heel on ground when walking.

Jan. 13: No progress. To wear flat shoes.



FIG. 325.
Case 9. July 30, 1926.



FIG. 326.
Case 9. July 30, 1926.

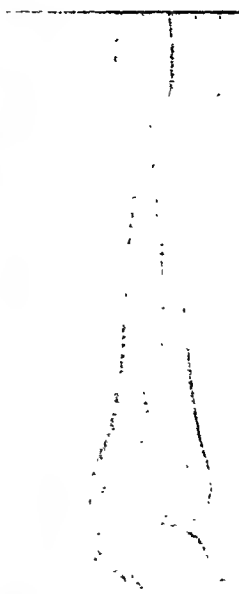


FIG. 327.
Case 9. July 21, 1927.

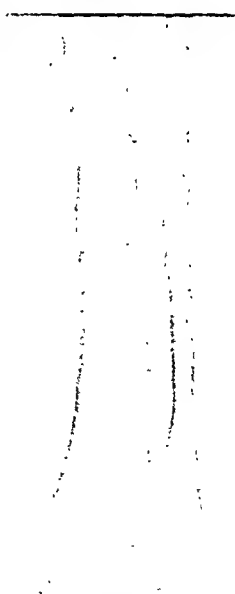


FIG. 328.
Case 9. July 21, 1927.

LATE RESULT.—Seen on July 21, 1927, patient stated that she used two sticks till May, 1927; since then no incapacity at all. On examination she was found to walk without limp in shoes; slight limp without shoes. Slight irregularity over front of tibia; $\frac{1}{2}$ -in. shortening. Dorsiflexion at ankle just short of sound side.



FIG. 329.
Case 11. Aug. 18, 1926.



FIG. 330.
Case 11. Aug. 18, 1926.

Case 11.—Leg fracture, upper fourth. Modified long Delbet plaster (Figs. 329-332).

C., male, age 74, caretaker. On Aug. 13, 1926, was knocked down by a motor-car and had concussion; oblique fracture of upper fourth of both bones left leg with slight abduction deformity.

Aug. 19: General anaesthetic, manipulation. Long Delbet plaster.

Sept. 1: Sits up half day.

Sept. 15: Walked with help.

Sept. 22: Walks well with sticks. Can walk without sticks.

Oct. 10: Walking with one stick. Plaster removed: $\frac{1}{2}$ -in. shortening, firm union, active flexion of knee to right angle.

Oct. 20: Walking fairly well without stick. Much ardema.

Oct. 24: Discharged. From this date led ordinary active life, going out daily, and walking up and down stairs. Using one stick. Returned to work after few weeks.

LATE RESULT.—Seen in July, 1927, patient had no limp; $\frac{3}{4}$ -in. shortening. Flexion of left knee 80 per cent. Pain in wet weather.

FIG. 331.

Case 11. July 15, 1927.

CONCLUSIONS.

Ankle Fractures.—

1. That X-ray examination should be made in all cases of ankle injury if severe enough to cause pain on walking; and especially that a true antero-posterior view be obtained.

2. That reduction by simple manipulation is sufficient in the great majority of recent cases. Open operation was not found to be necessary in the cases dealt with in this communication.

3. That full correction of both lateral and antero-posterior displacements of the astragalus is essential to the complete recovery of function.

4. That use of the Delbet plaster shortens considerably the period of treatment, as compared with other methods, and that it dispenses with the tedious and expensive course of physiotherapy required by them.

Leg Fractures.—

1. That actual anatomical restoration is not essential in order to regain perfect function, provided that angulation and shortening of more than one inch are corrected.

2. That full weight-transmission through the seat of fracture, made possible by using the Delbet plaster in these cases, stimulates rapid formation of strong callus and so shortens the period of treatment.



FIG. 332.—Case 11. July 15, 1927.

The writer wishes to thank Mr. Gwynne Williams for permission to publish his cases, for his valuable instruction, and his kind advice in the preparation of this article; also he is indebted to the Medical Superintendent of the Islington Infirmary, London, for permission to publish cases.

REFERENCE.

¹ DELBET, MARCHACK, MOSSE, and LEMARE, *Méthode de Traitement des Fractures*, Paris, 1916.

A CASE OF ACTINOMYCOTIC ULCERATION OF THE DUODENUM AND JEJUNUM.

BY SIR W. J. DE COURCY WHEELER,

VISITING SURGEON TO MERCER'S HOSPITAL, DUBLIN.

So far as can be ascertained from the literature, ulceration of the duodenum or jejunum from actinomycotic infection is very rare. Details could not be found of any cases resembling that which is briefly recorded in this communication. Yet actinomycosis of the buccopharyngeal region is quite common. The fungus gains access to the tissues in this situation through small abrasions during mastication, especially in the presence of defective teeth. There is a plentiful supply of the ray fungus in cereals and grasses. Fresh fruit and vegetables may be contaminated easily when packed in straw.

It is interesting to speculate on the fact that the lower jaw, the tongue, and the peribuccal tissues are readily infected, and that the pharynx and oesophagus do not always escape, and nevertheless the stomach and small intestine are practically immune. Cope, quoting Poncet, states that the thorax is frequently infected by way of the oesophagus, and that infection from the stomach and small intestine is almost unknown. It is suggested that the acid gastric juice either kills the fungus or inhibits its activity, whilst the fluid contents of the small intestine are unlikely to produce any abrasions through which the streptothrix might escape. An attack of appendicitis, on the other hand, readily gives the opportunity for which the actinomycotic organism is waiting, with the result that cecal actinomycosis is relatively common. The immunity of the stomach and small intestine is more inexplicable when it is remembered that small breaches of surface are often present in the mucous membrane of the small intestine, especially the duodenum, and hydrochloric acid is absent or diminished in many common ailments. There appears to be no valid reason discoverable why infective material swallowed in the food should not find more often a suitable nidus for development in these high situations.

In 1924, a man of 40, a painter, was admitted to the wards of Mercer's Hospital, Dublin. He had been ill for four months suffering from vague abdominal pains, with loss of weight, loss of appetite, and gastric stasis. His temperature ranged from 99° to 101°, and cachexia was well marked. Early in the course of his illness his medical attendant in the country noticed transitory jaundice and bile in the urine. Shortly after admission to hospital he had a severe hæmatemesis. Routine bedside examination revealed nothing except tenderness and some rigidity over a wide area above the umbilicus. Hydrochloric acid was absent from the stomach contents, and raisins given at night were found in plenty on washing out the stomach the following

morning. Blood cultures were reported as negative. Only an incomplete X-ray examination could be made owing to structural alterations in the hospital: when the patient was examined in the erect position the stomach was found to be dilated and hypotonic. The report stated that there was diffuse narrowing of the pyloric segment and gross irregularity of outline in both curvatures. There was a very large six-hour residue. It was explained that the patient could not be examined in the horizontal position, but that so far as the examination went there appeared to be pyloric obstruction, almost certainly due to carcinoma. In the light of later events it became obvious that the gross irregularity was in the duodenum, the stomach having dropped in front of the ulcerated duodenum when the patient was in the erect position. The clinical diagnosis was cancer of the stomach.

The abdomen was opened in the middle line above the umbilicus. The stomach and the first portion of the duodenum were examined and were found free from ulceration or other abnormality. A general exploration was carried out, and a loop of the jejunum about one foot from the duodenojejunal flexure was found to be the site of a tumour about the size and shape of a bantam's egg. The affected coil was adherent to the omentum and to neighbouring coils of intestine. The adhesions were easily detached, and when the tumour was isolated it was found to be red and acutely inflamed on the surface, with much the appearance of an acute appendix before perforation had taken place. In two or three places perforations closed by loose adhesions passed through the inflamed areas into the lumen of the intestine. The loop of jejunum was resected and the intestine united by end-to-end anastomosis. No other lesions were discovered at operation. On the eighth day after operation the patient got a sudden pain; perforation had obviously taken place, and he died in a few hours.

At the post-mortem examination carried out by Dr. T. T. O'Farrell, the third portion of the duodenum was found to be ulcerated in much the same manner as the loop of jejunum which was resected. The immediate cause of death was leakage at the line of anastomosis.

Before the specimens were investigated by the pathologist no opinion could be formed as to the nature of the lesion in the jejunum. It was unlike tuberculosis of the small intestine, there was obviously no impaction of a foreign body, and the site of the lesion and the acute inflammatory condition almost excluded malignant disease. The accompanying coloured drawings of the specimens were made immediately after operation.

Having regard to the post-mortem findings, the remarks of Sandford and others¹ are of interest:—

"Formerly we followed the suggestion of J. Homer Wright and others as regards nomenclature, calling actinomycetes only an organism of the type *Actinomyces bovis*, forming typical 'sulphur granules' with club-shaped rays, not acid-fast, and growing with difficulty in cultures, usually anaerobic. Our previous Report was made only on cases that were definitely infected with organisms of this type, the term 'nocardiosis' being applied to the disease in which the infection was caused by so-called nocardia or streptothrix, or any of the actinomycetes that grow aerobically and are acid-fast. However, the Committee on Nomenclature of the American Society of Bacteriologists in its final report has recommended that all organisms of this type be now classified under the general name 'actinomycetes'".

New and Figi point out the fallacy of the general belief that the most common means of infection is by direct contagion from the lower animals, the patient being generally asked if lumpy jaw exists amongst the animals in the neighbourhood. It is more likely that the organisms abound on the vegetation of the locality, rather than that the diseased animals are the primary cause of the infection in man. They refer to the picking of decayed teeth with straws or chewing bits of straw or grass as likely to produce the disease. Infection from one person to another is stated to be very unlikely.

Sandford and Magath¹ contribute also to the work on actinomycosis, and, amongst many other interesting facts, they state that there are two cases in the literature of actinomycosis of the finger, resulting from injury inflicted by an opponent's tooth in a fist fight. In both of these cases the inference is that actinomycosis was present in the oral cavity of a person who was not suffering from the clinical manifestations of the disease.

The present case illustrates the fact that occupation is not a determining factor in the etiology of actinomycosis: the patient was a painter; and probably about 50 per cent of the cases are not farmers, nor are they brought directly into contact with cattle or grain.

The facts that the glands in the present instance were not involved, and that peritonitis apart from the perforation was absent, make the picture of actinomycosis more complete. These are striking features of actinomycosis, and serve to distinguish it from other forms of infection, and especially from tubercle². The peritoneum resists attack in a remarkable manner. Large masses, the result of actinomycosis, may be found within the abdomen, abscesses may require drainage, but peritonitis is seldom seen either as a primary lesion or as a post-operative complication.

In a very full clinical study of actinomycosis, Cope² discusses the regional distribution under the following groups: (1) Upper alimentary canal—buccopharyngeal; (2) Lower alimentary canal—cecal and appendicular infection; (3) Thorax; (4) Miscellaneous—skin, genito-urinary tract, etc. There is no mention of involvement of the intestinal tract between the lower end of the oesophagus and cecal region. It is mentioned that the liver is frequently attacked, but it is difficult to believe that this is more than a metastasis from some other focus in the alimentary tract.

Helwig³ reports cases of actinomycosis of the ovary and tube, and brings out the interesting fact in a table of reported cases of actinomycosis that 20 out of 30 cases were secondary to an intestinal lesion. In nearly all these cases the primary lesion appears to have been in the appendix region, mesosigmoid, sigmoid colon, rectum, or large intestine or liver.

Four cases which had their origin in the small intestine are mentioned, but no details are given.

Seventeen cases of actinomycosis are tabulated by Sandford and Magath¹ according to the anatomical distribution as seen in the Mayo Clinic. In none of these was the small intestine involved. A hundred and nineteen cases were collected from the literature and tabulated in like manner: one of this group was classified 'intestine and liver', another 'omentum and intestine'.

Mattson⁴ states that there are two modes of invasion. One, which is very rare, is the generalized infection of the entire mucous membrane of the intestinal tract: only one case is on record. The other mode of invasion, which is quite common, is through the appendix.

PATHOLOGICAL REPORT.

By T. T. O'FARRELL.

The material from this case consisted of: (1) A segment of jejunum removed by operation; and (2) Organs removed at autopsy.

Segment of Jejunum Removed by Operation.—This piece of intestine, which is about 10 cm. long, shows two perforations on the peritoneal aspect (*Fig. 333*), one on either side of the mesenteric attachment and about 1.5 cm. from it. The intestine about the perforations is inflamed, and some greenish slough projects from the openings. Apart from the inflammation in the immediate vicinity of the perforations there is relatively little peritonitis.

When received, the bowel had been opened along its free border. The mucous surface presents two transverse ulcers (*Fig. 334*) which are partly confluent and extend circularly around almost the entire circumference of the intestine. The ulcers are from 1 to 1.5 cm. in diameter. The edges are ragged and partly undermined, and there is a red line of intense inflammation about their margin, next to which the mucous membrane looks normal. On the whole there is comparatively little thickening of the intestinal wall. The floors of the ulcers are slaggy and covered by a dark-greenish, adherent slough. For the most part the ulcers involve the mucous and submucous coats, but at two points they extend through the muscle to the peritoneal coat where the perforations are situated. To the naked eye there is no evidence of tubercle, and the amount of thickening is much less than occurs in that condition.

Microscopical sections were made through the floor of one of the ulcers, including some of the adjacent comparatively healthy-looking mucous membrane. Sections were stained by hæmatoxylin and eosin, Gram-Weigert's, Unna-Pappenheim's, and Ziehl-Neelsen's methods.

The surface of the ulcer is covered by necrotic material, containing a moderate number of pus-cells and many bacteria. Beneath this the inflammation is of a more or less subacute or chronic type, plasma-cells are very numerous, and the general background of the structure is that of granulation tissue. There are some capillary blood-vessels, some extravasated red blood-cells, and a moderate amount of fibrin.

In the sections examined this inflammatory process extends downwards to the muscular layers, the muscle being partly infiltrated by plasma-cells and small lymphocytes. The mucous membrane at the edge, though intact, shows similar infiltration for some distance on either side of the ulcer. There is nothing suggestive of tubercle. The bacteria in the slough are cocci and bacilli, some of the latter being long and filamentous. In the floor of the ulcer there are several clumps of micro-organisms composed of branching

partly-beaded filaments arranged fan-wise in a radiating fashion, very suggestive of a streptothrix. The filaments retain Gram's stain, methylene blue, and pyronin. Fibrin, where present, though retaining the Gram's stain, is unaffected by the other two dyes. The organism is not acid-fast. Some clear areas resembling 'clubs' were found, but a successful stain was not obtained.

None of the organisms could be found in the muscular layers of the bowel. There is no evidence of malignant disease.

Post-mortem Examination.—The subject was much wasted; post-mortem rigidity and staining were well marked. A light-brown pigmentation was present on the skin of the axillae and groins, as also on the extensor aspect of both forearms, and to a certain extent on the back of the hands.

The operation wound in the middle line was opened; immediately beneath the stitches pus was found, particularly at the upper angle. The omentum was adherent to the parietal peritoneum. On separating the parts carefully, the intestinal anastomosis was found, about 37 cm. from the duodenojejunal flexure. The anastomosis was perforated, and separated on slight handling.



FIG. 333.—Drawing made immediately after operation, showing inflamed jejunum with perforations.

There was apparently no attempt at healing. The mesenteric attachment at the base of the anastomosis was greenish and somewhat gangrenous. There was a considerable amount of seropurulent fluid in the abdominal cavity. Posterior to the anastomosis the coils of the small intestine were adherent, and the peritoneum there was covered by a greenish exudate. The intestine from the duodenojejunal flexure to the rectum was removed and opened, and appeared healthy. The mesenteric glands were somewhat enlarged.

A dissection was made of the stomach, duodenum, and pancreas. The spleen was somewhat adherent, firm, and dark in colour. The pancreas was firm, particularly towards the tail. On dissecting the second stage of the duodenum from the front of the right kidney it was found adherent, and upon trying to separate the parts a perforation was made into the gut. On the left side a perforation was found in the third stage of the duodenum, near the point where it joins the jejunum, and the retroperitoneal fat was inflamed.

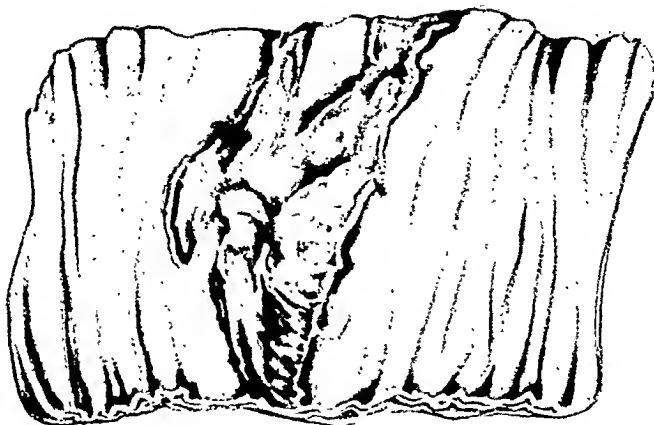


FIG. 334.—Jejunum opened, showing two transverse ulcers partially confluent. The ulcers encircled the segment of intestine.

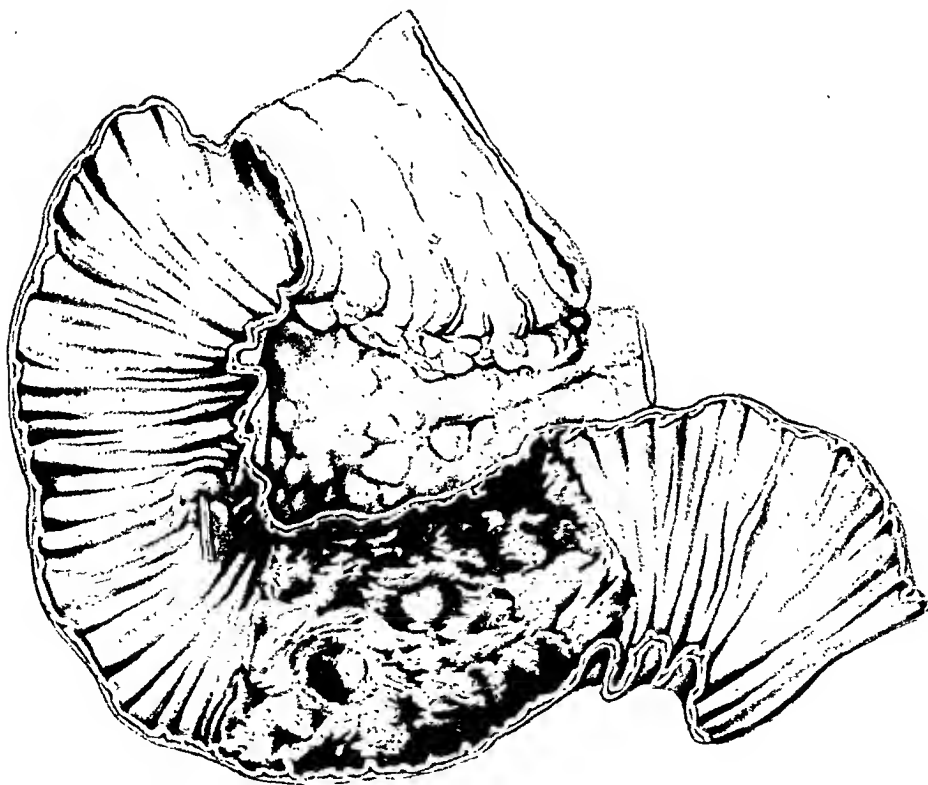


FIG. 335.—Large duodenal ulcer found post mortem, extending from the bile papilla to the duodenojejunal flexure and encircling the entire circumference.

Upon opening the stomach and duodenum a large ulcer was found (*Fig. 335*), beginning at the bile papilla, extending lengthwise as far as the duodenojejunal flexure, and circularly around the whole lining of the bowel. The ulcer had extended very deeply, and the floor was partly formed by the pancreas and the connective tissue of the posterior abdominal wall. The ulcer resembled that previously found in the piece of resected jejunum, but was more extensive and had a more shaggy greenish base. The floor was composed of a ragged mass of necrotic tissue resembling a mop.

No foreign body was found in any part of the intestinal tract. The liver showed some chronic venous congestion. The kidneys were congested, and the medullæ of the suprarenals were soft and almost liquid. The abdominal vessels were normal. An examination of the thorax failed to reveal any lesion except emphysema and some chronic pleurisy on both sides, particularly about the base of the left lung. The bronchial glands were enlarged. There was no evidence of tubercle or abscess formation. The heart was flabby, but showed no naked-eye evidence of fatty degeneration. The brain was not examined.

Pieces of tissue were selected from various organs for microscopical examination, but the only ones which presented features of interest were as follows: (1) Sections through the floor of the ulcer in the duodenum; (2) A lymphatic gland from the vicinity of the ulcer; (3) A mesenteric gland. A similar method of staining was adopted to that in the case of the jejunal ulcer.

1. *Ulcer of the Duodenum.*—This presented a similar picture to that of the jejunal ulcer, excepting that part of the floor of the ulcer was formed by the pancreas, which showed interstitial pancreatitis. Bacteria were present in the slough, and filamentous forms were numerous. Plasma-cell infiltration was remarkable. No giant cells were found. Round-cell infiltration was perhaps more marked than in the jejunal ulcer. None of the micro-organisms were found in the deepest part of the ulcer.

2. *Lymphatic Gland from the Vicinity of the Ulcer.*—This presented a curious appearance. The lymphoid tissue was separated off into islands by bands of young fibrous tissue which contained very numerous plasma-cells and some lymphoid cells. There were no pus-cells, and no micro-organisms could be found.

3. *Mesenteric Gland.*—This showed a somewhat similar appearance to the previous gland, plasma-cells being in evidence, but there was practically no fibrosis and somewhat less round-cell infiltration. No micro-organisms could be demonstrated. In none of the organs examined could any trace of tubercle or tumour formation be found.

CONCLUSION.

This patient suffered from a rare, severe, ulcerative condition of the duodenum and jejunum. The ulceration was of an almost diphtheritic type with comparatively little suppuration, the tissue reaction being mainly of the plasma-cell type with lymphoid-cell infiltration. Many micro-organisms were found in the superficial sloughs, the preponderating one being of streptothrix type. Organisms of the 'ray-fungus' type were found in the floor of the

jejunal ulcer, but only in the slough of the duodenal one. As no streptothrix was found in the lymphatic glands it is difficult to state with certainty that it was the causal agent of the ulceration, but there is sufficient evidence to consider it as being a likely factor in the process. According to Cope secondary deposits in lymphatic glands are unusual.

I am deeply indebted to Dr. T. T. O'Farrell for the infinite trouble he has taken in making the pathological examinations, and to Sir Berkeley Moynihan and Professor Stewart for supervising the painting of the illustrations from coloured pictures made at the time of operation and post-mortem examination.

REFERENCES.

- ¹ SANDFORD and others. *Collected Papers of the Mayo Clinic*, 1921 and 1923.
- ² COPE, V. ZACHARY. *Brit. Jour. Surg.*, 1915, iii, July, 59.
- ³ HELWIG. *Surg. Gynecol. and Obst.*, xl, 502.
- ⁴ MATTSOY, *Ibid.*, xxxiv, 486.

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- ³ HELWIG, *Surg. Gynecol. and Obst.*, xl, 502.
- ⁴ MATTSO, *Ibid.*, xxxiv, 486.

CONGENITAL MALFORMATIONS OF THE MESENTERY: A CLINICAL ENTITY.

By GEORGE E. WAUGH,

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NEARLY all varieties of malformation of the mesentery and malposition of certain parts of the intestine dependent upon a disorder of reduction, rotation, or fixation of the mid-gut loop from what N. Dott¹ describes aptly as "a temporary and physiological umbilical hernia" to the abdominal cavity proper throughout the fifth to the eleventh week of fetal life, have been dealt with by many writers. To anyone desirous of understanding the subject the work of J. E. Frazer and R. H. Robbins² and the lucid and masterly writings of N. Dott¹ are worthy of the most careful study. Nevertheless, nearly all the observations recorded have been made as the result of accidental findings during the course of abdominal operations for other conditions; or at operations for acute abdominal emergencies that may have arisen from such malformations, e.g., volvulus and acute intestinal obstruction; or from deliberate studies in embryology carried out in the post-mortem room. So far these gross congenital malformations do not appear to have been described in literature as definite clinical entities, characterized by definite clinical signs and symptoms, and diagnosable by clinical observations upon children who are the victims of vague abdominal disorders of a chronic nature. In the presence of acute abdominal crises which have progressed to acute intestinal obstruction they have been recognized accurately beforehand; but in milder forms the clinical features which appear to enable them to be filched from the rubbish heaps of 'dyspepsia' and 'chronic appendicitis' do not seem to have been noted so far. It is the purpose of this paper to attempt to describe these features, and its justification must be the successful diagnosis, by clinical methods beforehand, of the presence of these malformations in 4 cases out of 5 seen within the last two years, and the subsequent confirmation at operations on each case undertaken deliberately for the purpose of rectifying the lesion as far as possible.

No attempt was made at such a diagnosis in the fourth case, because all the symptoms were overshadowed by those of a very acute attack of appendicitis from which the patient had just emerged. Even in this case important physical signs were noted beforehand, but were not stressed in view of the urgent need for the removal of the appendix. The other four cases had been under continuous treatment for 'indigestion' from early childhood at the hands of many experts. It is of importance to note that this 'indigestion' made its appearance within the first few months of life, and was characterized by attacks of pain of an intensity that would be impossible to explain on the theory of a functional inability of the patients' alimentary tracts ever to digest

the many variations of diet that were offered to them. Further, the frequent recurrence over a period of years of attacks of violent abdominal pain that disappeared spontaneously on each occasion before a catastrophe happened, and left no trace behind them of detectable organic change in any of the intra-abdominal organs or their functions, comprises a sequence of events that cannot be associated with any of the well-known surgical lesions. Least of all is this characteristic of any form of appendicular trouble, although, *faute de mieux*, 'chronic appendicitis' was suggested ultimately in three of these cases. The refusal of the parents to accept the true diagnosis in one case—which was countered by a refusal to operate for the purpose of removing the appendix—led to their refusal to permit an operation for the investigation of a congenital malformation. The child was taken away for further treatment at the hands of another physician, and only fifteen months later was she brought back with no amelioration of her trouble and with the parents now willing to agree to the type of operation originally suggested (*Case 1*). In studying the details of the cases here recorded it is important to bear in mind that the segment of intestine involved is the mid-gut only, which the writers already referred to have defined as extending from the biliary papilla of the duodenum to the mid-point of the transverse colon, or alternately as all that part of the intestine which receives its blood-supply from the superior mesenteric artery.

SYMPTOMATOLOGY.

Pain.—When the pain experienced by these patients is subjected to a careful clinical scrutiny of its quality, situation, distribution, duration, and relationship to posture, to the taking of food, and to the action of the bowels, a composite mental picture of *unusualness* is at once gained. No ready-made picture leaps to the mind that can explain such a grouping by reference to any of the common and well-known surgical lesions. Children unhampered by leading questions, and with no prejudice that adults may show sometimes in the direction of trying to give an answer which they wrongly imagine the questioner wants, can describe with dispassionate accuracy where their pain is situated, and in a few simple terms can sum up its quality. This 'unusualness' can be appreciated perhaps from the following epitome:—

Case 1.—"The attacks of pain were of a violent and paroxysmal nature, experienced in the region of the right hypochondrium, and might last for only a few minutes or for a couple of hours. In the worst attacks the child would throw herself upon the floor and scream. They were liable to come on peculiarly during exertion, most frequently when she was running about playing out of doors, or towards the end of the day when she was having a final romp in the nursery before going to bed. They had no time relationship to food, and appeared to be quite unrelated to regularity or irregularity in the action of the bowels. They had been present from early childhood." (*See Figs. 336, 337.*)

Case 2.—"A gnawing pain was experienced over the area of the stomach entirely to the left of the middle line. It always began a few moments after swallowing the first few mouthfuls of a meal. It increased in intensity during the progress of the meal, and finally reached its maximum at the end of the

meal. From this point it began to die away gradually and as a rule had just disappeared before the next meal was due. It was always worse during the two big meals of the day, breakfast and dinner. Posture had no effect upon it except that the patient could endure an inevitable evil more comfortably when she was lying down, and no regulation of dietary or action of the bowels had any effect upon it." (*See Fig. 338.*)

Case 3.—"A pain like 'a bad stomach ache' was experienced on the left side of the abdomen, spreading well out to the left flank. A constant series of changes observed by the mother heralded and ushered out each attack. Their order was: Daily motions became small and pipe-like, then complete constipation for a few days, then a slow symmetrical swelling of the whole abdomen began which was followed after a varying period by the attack of pain. This might last for an hour or two or for most of the day, and was always relieved by the spontaneous passage of several enormous formed motions. The attacks of pain were not affected by posture, or by changes in diet and drugs, which had been administered for several years." (*See Fig. 339.*)

Case 4.—The malformation described was an accidental discovery at an operation for the removal of a recently inflamed appendix containing pus. (*See Fig. 338.*)

Case 5.—"The pain was very violent in character, and was experienced by the patient in the mid-epigastric region. The first attack occurred before he was 2 months old, and was accompanied by continuous vomiting, which became biliary in character. By the time he was 7 years old it was easy to recognize that these attacks were characteristic of an obstructive lesion high up in the alimentary tract."

Vomiting.—This was an entirely erratic symptom and was rare, except in *Case 5*. It only occurred in *Cases 1* and *3* occasionally; it tended not to be continuous, but appeared rather as a single reflex act of vomiting in attacks when the pain was most intense, and the quantity and nature of the vomited material appeared to be determined entirely by what happened by chance to be in the stomach at the time.

Abdominal Examination.—In four cases a sense of *emptiness* of the right iliac fossa was a most arresting physical sign. This fossa is filled normally by large and small intestine, both of them being components of the mid-gut. Bearing in mind that these malformations affect the segment of mid-gut only, it is clear that one or other of its components must be absent from the right iliac fossa, and although it is not possible to dogmatize about which component is missing, it is quite easy to determine that the fossa is not normally filled and that one or other component must be absent; in *Case 3* I stated beforehand that the emptiness of the right iliac fossa was due to the absence of the ascending colon, and this was proved to be quite wrong at the subsequent operation! (*See Fig. 339.*) Emptiness of this fossa has been described as a sign of intussusception; it very rarely is so, because in this disease the fossa as a rule is more than generously filled by coils of over-distended intestine which can be seen to occupy it during the course of the operation.

An asymmetrical fullness is a fairly constant sign. It was noted in *Cases 2, 3, 4, and 5*. In *Cases 2* and *4* the whole of the colon was a left-sided

viscus; in *Case 3* the whole of the small intestine was lying external to the left colon and was a purely abdominal viscus shut off entirely from the pelvis. In all these cases the whole of the left side only of the abdomen was swollen obviously on inspection; palpation confirmed an abnormal fullness without any evidence of tumour formation. In *Case 5* the whole of the upper half of the abdomen was swollen; below the umbilicus it appeared abruptly flat.

X-ray Examination.—Radiography applied with the special purpose of confirming the clinical diagnosis of congenital malformation proved to be disappointing on the whole. In *Case 1* a high cæcum was revealed (*see Fig. 336*); but the intimate relationship of the duodenum and terminal part of the ileum enclosed by a band of omentum could not, of course, be shown. No help was obtained from pictures of the other cases; but it was not realized until after the operation on *Case 3* that the best way to obtain information as to the relative positions of the small and large intestines is to give a barium meal by mouth, and, when this has been seen on the screen to be giving a good definition of the small intestine, to administer a barium enema and thus obtain a composite picture. This method was adopted for *Case 3* two months after operation, when a perfect picture was obtained showing that the small intestine now occupied its normal position between the three segments of the large bowel.



FIG. 336.—*Case 1*. Examination in the prone position four and three-quarter hours after barium meal. X indicates a high cæcum.

DETAILS OF CASES.

Case 1.—N. B., age 6½ years, female, was first seen on Feb. 25, 1925, with Dr. H. Waller.

HISTORY.—She had had a ‘weak digestion’ from infancy, and had been under continuous treatment for this by a consulting physician for the past three years. Details of the attacks of pain, which were a conspicuous feature of her weak digestion, have already been given (*see p. 439*); they had been present from her earliest childhood. The parents had been advised now that the appendix ought to be removed.

ON EXAMINATION.—The singular emptiness of the right iliac fossa was noted, but nothing else abnormal was detected. Skiagrams seemed to show that the cæcum

was under the liver (*Fig. 336*). Taking these findings in conjunction with the details of her attacks of pain, a diagnosis of congenital malformation of the mesentery was made and operation advised. The parents refused to agree to this, and as they were met with a refusal to remove the appendix, the child was placed under the care of another dietetic specialist for a further period of fifteen months. At the end of this time the child's sufferings had been entirely unaffected, and consent was given now to the performance of the operation advised originally.

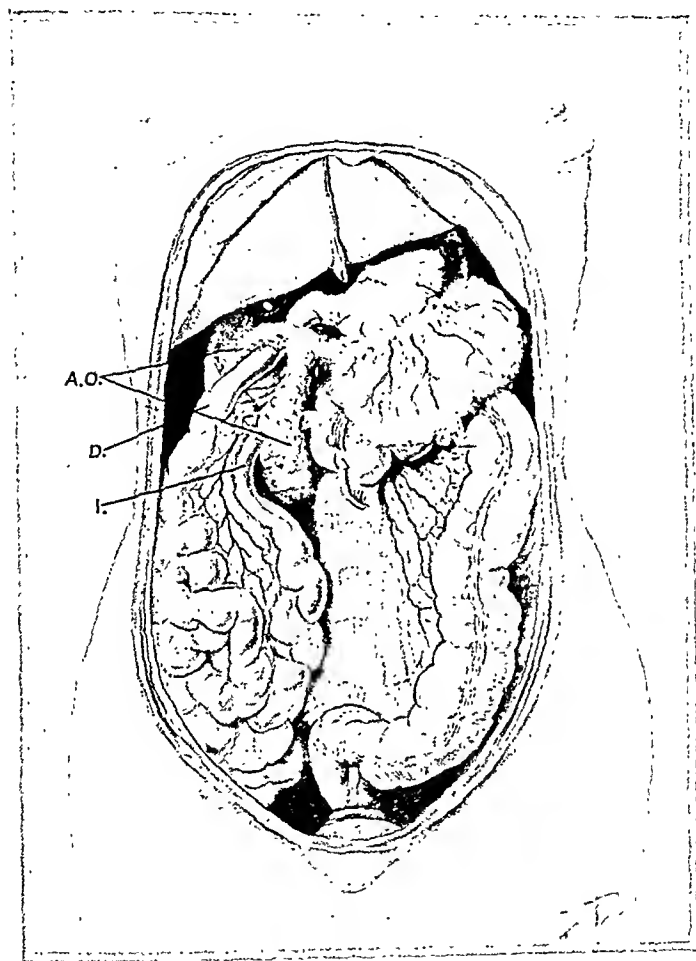


FIG. 337.—*Case 1.* A.O., Abnormal band of omentum encircling; D., Duodenum; I., Terminal part of ileum; and the root of the mesentery containing the superior mesenteric vessels. The whole of the small intestine is at the right side of the abdominal cavity.

OPERATION.—Laparotomy was done on June 9, 1926. When the abdomen had been opened by reflecting the right rectus outwards, the whole of the small intestine was found to be on the right side. The duodenum was a straight tube with the terminal portion of the ileum close alongside and parallel to it. These two portions of the small intestine were bound together by a stout anomalous band of omentum which completely encircled them, and at the same time enclosed the whole of the mesentery which contained the superior mesenteric vessels (*Fig. 337*). The ileum

joined the cæcum immediately below the greater curvature of the pyloric end of the stomach; from the cæcum the large intestine passed directly to the left, so that the ascending and transverse colons appeared to be represented by a short segment of colon between it and the splenic flexure. The colon on the left side was voluminous. A small and entirely healthy-looking appendix was removed. The anomalous band of omentum was resected freely so as to liberate entirely the pedicle formed by duodenum, superior mesenteric vessels, and ileum which was constricted by it. A congenital foramen (not shown in the sketch) in the mesentery of the small intestine was closed. Nothing else abnormal was found.

RESULTS.—The child had an easy recovery, and up to the present time, October, 1927, has remained perfectly well without any recurrence of her former troubles. It would appear from a survey of all the details of the case that the constricting band of omentum was the chief factor in producing the attacks of (violent) abdominal pain, either by obstructing at intervals the lumen of one or other of the enclosed pieces of gut, or by forming a pedicle so narrow that torsion occurred in the direction of a volvulus which was prevented from becoming complete by the broad attachment of the omentum to the stomach. In favour of the latter view the liability of the attacks to be precipitated by active exercise is suggestive.

Case 2.—R. F., female, age 12 years and 4 months, seen in conjunction with Dr. R. S. Frew.

HISTORY.—All her life she had had a 'delicate inside', and at the ages of 4, 6, and 8 years respectively had had attacks of severe abdominal pain lasting for two days, and associated with the passage of blood and mucus from the bowel, so that intussusception had been suspected. Her own description of the internal pain experienced in the region of the stomach has already been given (*see p. 439*). She had been brought up on a careful diet and drugs to control the actions of the bowel daily, but at no time did she obtain any prolonged freedom from her gastric pains. She was sent up from her school at the seaside to London with a diagnosis of acute appendicitis, and I first saw her on April 22, 1925.

ON EXAMINATION.—It was appreciated that the right iliac fossa was obviously empty, and there was no tenderness anywhere. The left side of the abdomen in its lower half only was full. In view of the child's own excellent description of her pain, the presence of these signs appeared to justify the diagnosis of congenital mesenteric malformation; and the parents consented to an operation to investigate this condition. There were no signs at all of any acute illness, so that it was arranged for convenience that the operation should be done on May 6, 1925.

OPERATION.—The right rectus was turned outwards and the abdomen opened. The small intestine occupied the right side of the abdominal cavity, and the whole of the colon was on the left side: but, unlike the previous case, the cæcum was lying on the left side of the floor of the pelvis, where the ileum joined it. The ascending colon made a vertical ascent to reach the greater curvature of the stomach to the left of the middle line; from this point to the splenic flexure the transverse colon was represented by a short segment of gut only. The ascending colon was enclosed by the same primitive layer of mesentery as the small intestine; no secondary fixation had occurred anywhere, so that the whole weight of the primitive mid-gut was supported by the stomach. The condition was one of total reduction of the mid-gut with arrest of subsequent rotation and fixation. *Fig. 338* illustrates well its further subdivision into pre- and post-arterial segments described by Dott. A small and very innocent looking appendix was removed, and the abdomen closed with the feeling that no improvement could follow.

RESULTS.—The attacks of gastric pain recurred ten days later, and continued at frequent intervals throughout the following year. Treatment was devised after operation with a view to taking the weight of the colon off the stomach as much as possible. A supporting belt was ordered, which was put on when the child was 'upside down', a diet devised to leave the smallest amount of debris, and mild aperients and paraffin to secure a rather frequent emptying of the intestine. During the present year there has been some improvement in her condition.]

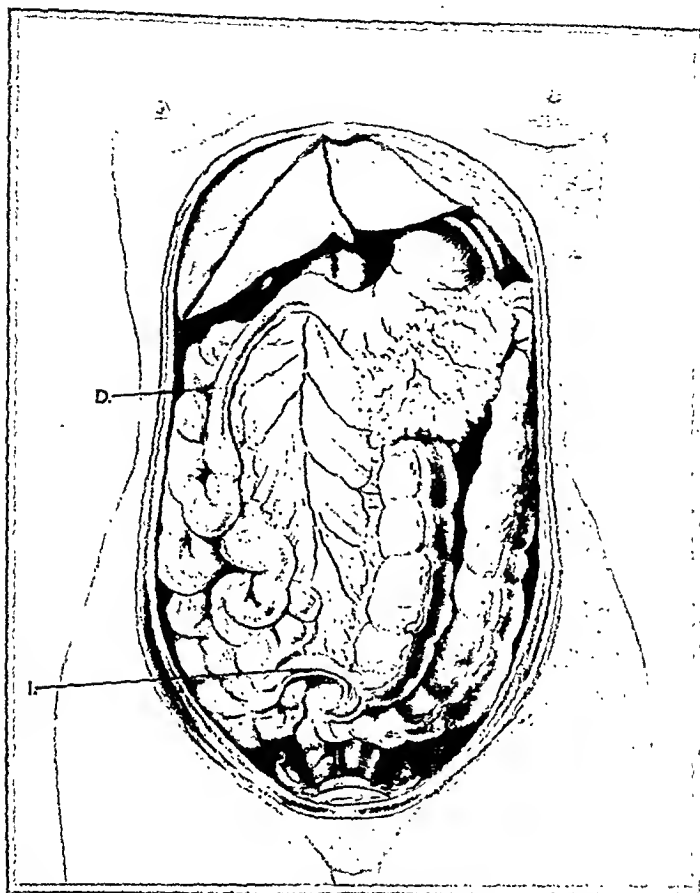


FIG. 338.—Cases 2 and 4. D, Duodenum; I, Terminal portion of the ileum. The whole of the small intestine is at the right side, and the whole of the large intestine on the left side of the abdominal cavity. In Case 4 the whole of the mesentery of the ascending colon was firmly attached to the left side of the bodies of the lumbar vertebræ. In Case 2 no fixation of the common mesentery of the whole loop of mid-gut had occurred.

Case 3.—L. B., male, age 10 years, was admitted to the Hampstead General Hospital on Jan. 28, 1927, under the care of my colleague, Dr. Scott-Pinchin, who kindly asked me to see the patient with him. Under observation in the ward an attack of left-sided abdominal pain, with distention of the abdomen and a passage alternately of 'pipe-stem' and enormous motions, had been noted.

HISTORY.—The full sequence of events which had been present from early childhood was described by the mother (*see p. 440*), who had taken him to many hospitals in London for treatment of his 'indigestion', and on two occasions had refused her permission for the removal of the appendix.

ON EXAMINATION.—He was first seen by the writer on March 21, 1927, when the left side of the abdomen was noticed to be obviously swollen; it was full on palpation, without any evidence of tumour formation, and the right iliac fossa felt abnormally empty. A diagnosis of congenital mesenteric malformation was made, with which Dr. Scott-Pinchin agreed, and operation was decided upon after further X-ray examination. The radiograms were not helpful, and it was only after operation upon this case that the right method of procedure was worked out.

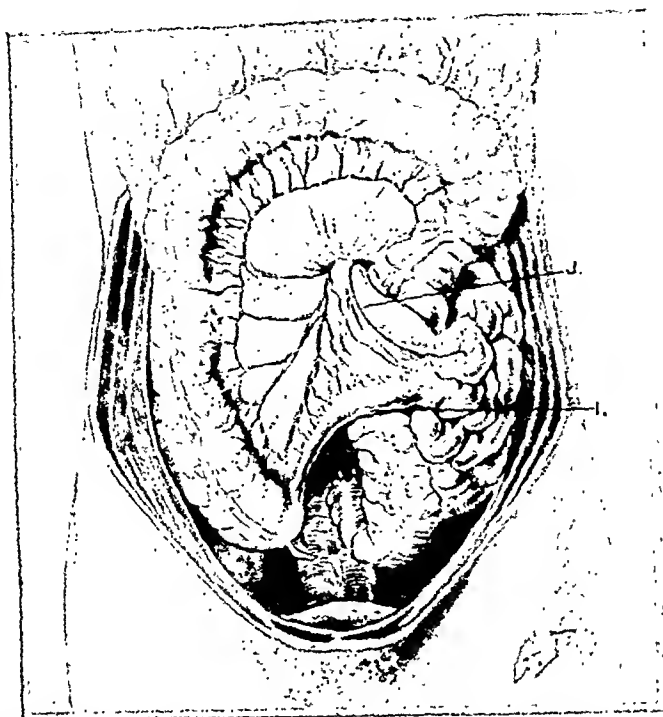


FIG. 339.—Case 3. J, First part of jejunum, and I, Terminal part of ileum, forming a pedicle crossing and tying down the descending colon, external to which the whole of the rest of the small intestine was lying on the left side of the abdominal cavity.

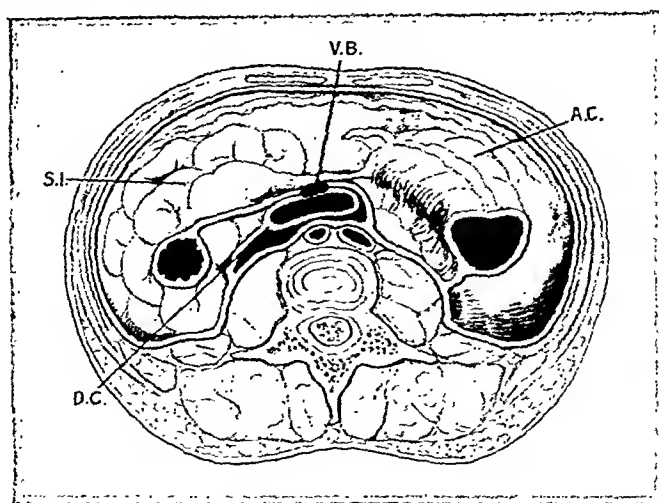


FIG. 340.—Case 3. Diagram of transverse section of abdominal cavity to show the descending colon flattened by the pedicle of the small intestine which crossed it, and the vestigial band joining the mesentery of the small intestine to the anterior surface of the descending colon. This band had to be cut through before the reduction of the small intestine to its normal position could be effected. D.C., Descending colon; S.I., Small intestine; V.B., Vestigial band; A.C., Ascending colon.

OPERATION.—Laparotomy was performed on April 1. The *left* rectus was turned outwards and the abdomen opened. It was then found that the first part of the jejunum and the terminal part of the ileum converged to a narrow pedicle crossing and tying down the mid-point of the left colon, external to which the whole of the rest of the small intestine was lying. This latter part was confined entirely to the abdominal cavity and left iliac fossa, since all access to the true pelvis was cut off by the iliac and pelvic colon (*Fig. 339*). Where the mesentery of the small intestine crossed the left colon it was tied to it by a stout band of primitive undifferentiated embryonic tissue and the colon was flattened (*Fig. 340*), and only when this had been cut through was it possible to reduce the small intestine to its normal pelvic and abdominal situation bounded by the three segments of the colon. It settled down here quite easily without any impediment to its circulation, and without showing any tendency to return to its abnormal position. A simple healthy appendix was then removed and the abdomen closed.

RESULTS.—The boy has remained quite well up to the present time, and has shown no tendency to a recurrence of the alternate small and large motions. Two months after the operation a skiagram of the abdomen was taken with the improved procedure, and the small intestine was clearly outlined lying in its normal position in relation to the colon. The clinical features of the case noted beforehand became easily understandable in the light of what was found at operation.

Case 4.—E. H., female, age 21 years, was seen with Dr. E. A. Seymour on Jan. 26, 1927. The symptoms of the attack of acute appendicitis from which she had just recovered need no description. They were confirmed at the subsequent operation, when an appendix full of pus with recent lymph around it was removed.

ON EXAMINATION.—The emptiness of the right iliac fossa was noted, as well as a slight fullness of the abdomen on the left side. No deductions were made from these very important observations, which were overshadowed entirely by a description of the symptoms of an acute illness from which the patient had just recovered successfully.

OPERATION.—Laparotomy was performed on Feb. 2. The lower half of the right rectus was turned outwards and the abdomen opened. The position of the viscera was identical with their position in *Case 2* (see *Fig. 338*). One difference—possibly of importance in view of the absence of a history of prolonged ‘indigestion’—was noted in this case. The ascending colon had acquired over its whole length a secondary attachment and firm fixation to the left side of the bodies of the lumbar vertebrae, and was not contained within the fold of primitive mesentery common to it and the small intestine; in *Case 2* the ascending colon had not formed any such attachment and was completely mobile.

RESULT.—The patient has been quite well since the date of operation when the appendix was removed.

Case 5.—A. V. R., male, age 7½ years, was admitted to the Hampstead General Hospital on Oct. 6, 1927, under the care of my colleague, Dr. Scott Pinchin, who kindly asked me to see the case with him.

HISTORY.—From early infancy the patient had suffered from attacks of severe abdominal pain and vomiting. The vomiting quite often occurred independently of the pain, was copious to begin with, continuous, and consisted ultimately of bile. At the age of 2 months he was admitted to a children’s hospital in London and was under treatment for one month as an in-patient. He was admitted during the following seven years to four other hospitals, but the attacks had continued unaffected by any form of treatment until his admission to the Hampstead General Hospital.

ON EXAMINATION.—He was a frail, sickly-looking boy when first seen on Oct. 6, and weighed 2 stone 9½ lb. The whole of the upper half of the abdomen above the transumbilical plane was distended symmetrically, and the lower half appeared flat by contrast. No mass formation was detectable, and visible peristalsis was noted high up in the *right* hypochondrium. This was clearly intestinal and not gastric

peristalsis. Radiograms of barium meals showed that retention occurred in an otherwise normal stomach for more than six hours. A second series of radiograms was taken after the administration of atropine, and these excluded pylorospasm as a possible cause of the trouble; a persistent organic obstruction of the pylorus was excluded by the presence of bile in the vomit; whilst congenital atresia of the duodenum or jejunum seemed unlikely in a patient who had reached the age of $7\frac{1}{2}$ years. A congenital mesenteric malformation was therefore diagnosed which acting

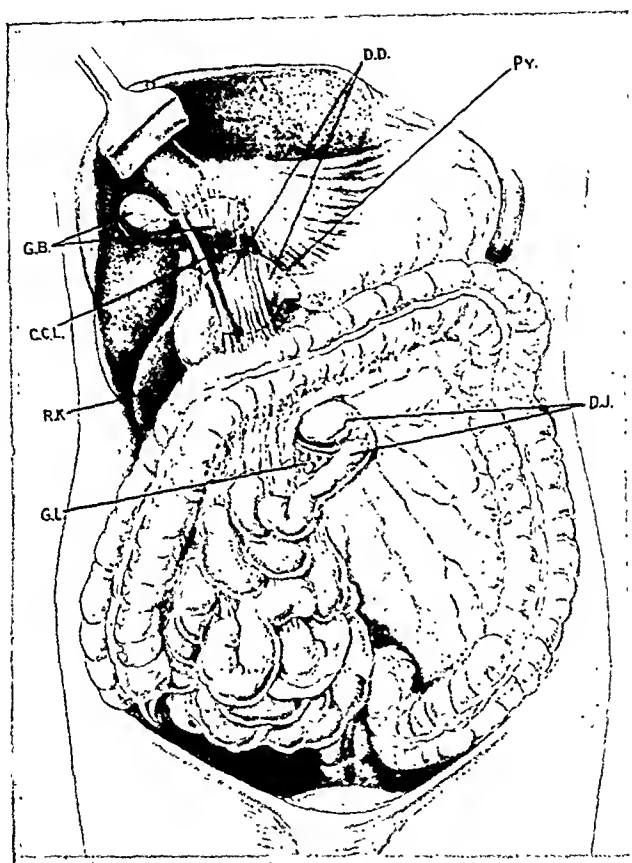


FIG. 341.—Case 5. GB, Gall-bladder in dotted outline beneath cysticocolic ligament; CCL, Cysticocolic ligament with thickened free edge; RK, Right kidney; DD, Dilated portion of duodenum in dotted outline beneath cysticocolic ligament; PY, Pylorus. The ascending colon and small intestine upon their common mesentery have been turned to the right to display the duodenojejunal junction (DJ). This shows an abrupt angle containing enlarged lymphatic glands (GL), and the terminal portion of duodenum dilated, in contrast with the lumen of the first part of the jejunum. The much larger masses of glands along both borders of the whole of the duodenum are not shown in the sketch.

as an extrinsic force produced intermittent obstruction high up in the alimentary tract.

OPERATION.—Laparotomy was performed on Oct. 27, and the upper half of the right rectus was turned outwards. The stomach appeared to be quite normal, and the pylorus was soft, devoid of irregularity, and admitted the tip of an index finger easily. An unusual form of cysticocolic membrane was found whose free edge was

thickened by a stout band. This band started at the transverse fissure of the liver and passed downwards across the gall-bladder, which it constricted into a figure of ∞ . It then continued over the anterior surface of the second part of the duodenum to end on the hepatic flexure of the colon. The duodenum was tightly constricted at this crossing and widely ballooned above it (Fig. 341). The whole of the membrane was cut away up to the foramen of Winslow, with immediate relief to the constrictions of both gall-bladder and duodenum. It was then noted that the whole of the rest of the duodenum appeared to have a slightly larger lumen than the jejunum, and that the first part of the jejunum was bent at an acute angle to the terminal part of the duodenum (Fig. 341). This appeared to be due to abnormal mesenteric attachments of the rest of the small intestine and the right colon. These viscera were contained in a common mesentery whose sole line of attachment posteriorly was the usual one of the small intestine only (Fig. 342). Consequently the whole weight of the colon and small intestine combined fell upon the vascular pedicle crossing the horizontal portion of the duodenum and upon the other fixed point of the gut, i.e., the duodenojejunal flexure. As, however, the dilatation of the duodenum that might be attributed to these two factors was much less than

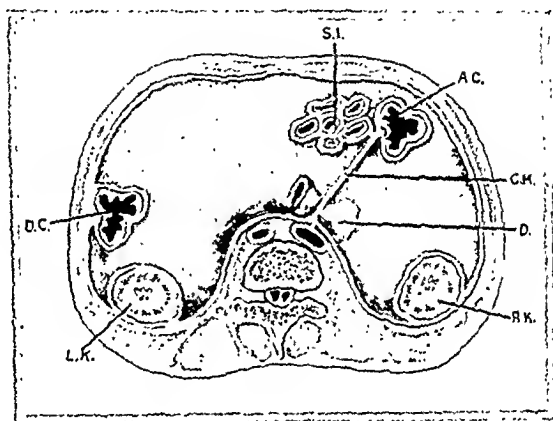


FIG. 342.—Case 5. Diagrammatic cross-section to show the common mesentery of the small intestine and colon and the relation of the vascular pedicle to the horizontal portion of the duodenum. S.I., Small intestine; AC., Ascending colon; CM., Common mesentery; D., Duodenum; RK., Right kidney; LK., Left kidney; DC., Descending colon.

the gross dilatation above the crossing of the cysticocolic ligament, it was decided to do nothing more for the present. If the progress of the patient does not continue in a satisfactory manner, then a relief of the strain on the duodenum either by fixation of the ascending colon or by the performance of a duodenojejunostomy, as advised by Wilkie, will have to be considered.

Another feature of great interest was the presence of enlarged lymphatic glands distributed along both borders of the duodenum and forming large clusters between the layers of the gastro-hepatic omentum, over the head of the pancreas, and at the duodenojejunal junction (Fig. 341). There were none in the whole of the rest of the mesentery, so that this distribution appeared to suggest that a simple infection had occurred by absorption from the retained contents of the duodenum. One gland was removed for microscopical investigation, and the pathological report was to the effect that the enlargement was due to simple inflammatory changes and that there were no signs of tuberculosis. A small healthy-looking appendix was removed at the end of the operation.

RESULTS.—The general condition of the patient has improved very much since the operation, from which he had a very easy recovery. Another series of X-ray

pictures taken on Nov. 17 shows that the stomach now gets rid of a barium meal at the end of three hours—that is, just twice as quickly as before the operation. He has had no further attacks of pain, and his weight had increased from 2 stone 9 lb. to 2 stone 12 lb. on Dec. 6, 1927.

CONCLUSIONS.

1. Congenital malformations of the mesentery are a definite morbid entity of a chronic type which may be recognized before operation by careful clinical investigation.

2. The symptom-complexes to which they give rise cannot be explained by reference to any of the well-known abdominal surgical diseases; still less by any purely functional disability which may be included under the term 'indigestion'.

3. The most important physical sign is the 'emptiness' of the right iliac fossa, associated sometimes with an asymmetrical enlargement of the abdomen on the left side. These signs follow of necessity, inasmuch as the whole segment of the embryonic mid-gut is involved in a failure of rotation and fixation after reduction from the umbilical sac.

4. Radiological investigation should prove to be more helpful in confirming the clinical diagnosis when the special method of examination already described is used as a routine.

5. Operative treatment may cure the patient; alternately it may reveal a pathological condition for which a rational course of treatment may be drawn up subsequently when the precise details of the malformation have been discovered.

The sketches were made by Dr. Georges Dupuy, to whom I am much indebted, and the radiogram was taken by Dr. W. H. Coldwell.

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- ¹ DOTT, N. H., "Anomalies of Intestinal Rotation", *Brit. Jour. Surg.*, 1923, xi, 251.
- ² FRAZER, J. E., and ROBBINS, R. H., "On the Factors Concerned in Causing Rotation of the Intestine in Man", *Jour. Anal.*, 1915, 1.

THE BACTERIOLOGY OF CHOLECYSTITIS: A CLINICAL AND EXPERIMENTAL STUDY.*

BY A. L. WILKIE, MONTREAL.

ON no subject does such diversity of opinion exist as on the nature of gall-bladder infections. On the one hand, such observers as Hurst,¹ Knott, and Venables assert that the colon bacillus is the organism most frequently responsible and that it can be isolated from samples of bile obtained by the duodenal tube. On the other hand, Rosenow² has laid stress on the important rôle which the streptococcus plays in gall-bladder disease and the intramural nature of the infection. As a true knowledge of the characters and the type of infection is fundamental to a rational therapy, it is of the first importance that definite data obtained by reliable means should be available. Illingworth,³ working in Professor Wilkie's clinic, obtained results which were roughly in accord with those of Rosenow in that he found that the streptococcus was the most frequent organism recoverable from diseased gall-bladders removed at operation.

The failure of so many observers to find the streptococcus in pathological gall-bladders must have been due to some factors in the technique employed. In this paper we hope to show what these factors are, and that an intramural streptococcic infection is by far the commonest cause of gall-bladder disease.

CLINICAL INVESTIGATIONS.

During the past few months the bacteriology of fifty consecutive cases of gall-bladder disease submitted to operation has been carefully worked out. The results obtained and their confirmation by experiment may help to remove a few of the difficulties attached to this most widely discussed subject.

The types of cases investigated may be broadly grouped under five headings: (1) Early acute cholecystitis (2 cases, rupture of gall-bladder in one case); (2) Early gall-bladder disease showing to the naked eye but slight thickening of the wall (6 cases); (3) Slight thickening of the wall associated with a single cholesterol stone (12 cases); (4) Advanced fibrosis of the gall-bladder wall without stone formation (10 cases); (5) Marked thickening of the wall with multiple stone formation (20 cases).

During the earlier part of the work Rosenow's method of culturing (1) the entire gall-bladder wall and (2) the submucosa† was employed. Along

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† The term 'submucosa' as used throughout this paper signifies the subepithelial layer. As pointed out by Halpert,⁴ there is no true submucosa in the gall-bladder comparable to that found in the stomach or intestine.

these lines it was found that a streptococcus (as described by Rosenow) could be isolated in a considerable number of instances from the submucosa, but that it was most difficult to obtain the same organism when the whole gall-bladder wall was cultured. If the bile were infected, then of course that particular infecting organism was obtained from the cultures of the entire wall. In the vast majority of instances, however, the bile was sterile, and, even though a streptococcus was isolated from the submucosa, cultures of the entire gall-bladder wall failed to reveal a growth.

It was therefore clear that the only difference between the cultures of (1) the entire gall-bladder wall, and (2) the submucosa and outer coats, was the presence in the former of mucous membrane coated with bile, which of course was not present in the latter. Furthermore, in making cultures from the submucosa the small portion of this layer taken might or might not contain at the time living micro-organisms.

Bile the Inhibitory Factor.—In order to explain the peculiar fact that entire wall cultures proved sterile whilst the submucosa showed streptococci, the organisms were treated with sterile bile. The sterile bile used in each case was obtained from the same gall-bladder from which the organisms were cultured. It was found that a few drops of bile inhibited the growth of the streptococci, and the organisms were ultimately killed, subcultures showing no growth. In other words, the streptococci isolated from the submucosa were not 'bile-resistant'. It appeared to be somewhat of a quantitative action, as more bile was necessary in heavier than in lighter growths to produce uniform results.

A great obstacle to the isolation of gall-bladder infective organisms, however, still remained, for the culturing of the submucous coat was very unreliable and not suited for bacteriological purposes when dealing with a number of cases at one time. The difficulty was obviated by Professor D. P. D. Wilkie, who suggested that in all cases of cholecystitis the cystic lymph gland should be carefully studied both histologically and bacteriologically. This gland, situated near the junction of the cystic duct and the gall-bladder, has now been shown to drain the entire submucous and outer coats of the gall-bladder. His proposal was carried out and has led to some very interesting and instructive results.

The importance of the study of the cystic gland in gall-bladder disease cannot be over-stressed, as it provides not only an easy but a certain means

RESULTS OF GALL-BLADDER AND CYSTIC-GLAND CULTURES
IN 50 CASES OF CHOLECYSTITIS.

| CULTURES FROM: | STREPTOCOCCUS | B. COLI | B. WELCHII | NO GROWTH |
|-------------------------------------|---------------|---------|------------|-----------|
| | Cases | Cases | Cases | Cases |
| Bile | 2 | 3 | 1 | 44 |
| Gall-bladder wall (all coats) .. | 2 | 3 | 1 | 44 |
| Submucosa .. | 21 | — | 1 | 28 |
| Cystic gland .. | 43 | 1 | 1 | 5 |

for the isolation of organisms which lodge and flourish in the gall-bladder wall. Using this technique, the results obtained were most striking, not only on account of the regularity with which organisms were found, but also in the uniformity of their type.

From the table the importance of cystic-gland cultures may readily be seen. In 43 cases the gland gave a pure culture of streptococci, in 1 case *B. coli*, in 1 case *B. welchii*, and in only 5 cases proved sterile. In the 43 cases all grades of cholecystitis were included. *B. coli* was isolated in one instance where a fault of technique could not be excluded, as the bile contained *B. coli* and there was a slight escape of gall-bladder contents during transportation from the operating theatre to the laboratory. *B. welchii* appeared in a case where a partial cholecystectomy had been done some years previously for an acute gangrenous cholecystitis. Of the 5 cases in which the gland proved sterile, in 2 the gall-bladder changes were very slight and the gland showed no enlargement. (As will be shown, cystic glandular enlargement is one of the first gross signs of cholecystic disease.) The 3 remaining cases in which the gland is tabulated as sterile presented gall-bladders so greatly thickened with long-standing disease that the cystic gland itself could not be isolated from the mass of fibrous tissue at the neck of the gall-bladder, and consequently a portion of this tissue was used for culture.

In addition to the cystic-gland cultures, the bacteriology of the submucosa, the entire gall-bladder wall, and bile was carefully studied in each case. As may be seen from the table, of the 43 cases which showed streptococci in the cystic gland, positive cultures of this organism were obtained in only 21 instances from the submucosa. This fact clearly demonstrates that with ordinary simple technique the organism may be recovered much more easily from the cystic gland than from the submucosa. When, however, streptococci were isolated from the submucosa, they proved to be of a type similar in every way to those recovered from the cystic gland.

The results obtained from culturing the gall-bladder wall (all coats) resemble those from the bile in every detail. The two cases which showed streptococci in the bile also contained streptococci in the cystic gland, but subsequent investigation proved that the two types were not similar. The strain isolated from the bile presented a rougher growth on agar, and appeared slightly larger than the organism from the cystic gland or submucosa, and when injected into animals no pathological changes resulted. It should be noted in passing that these bile-resistant streptococci were found in the two acute cases of the series, one of which showed a rupture of the gall-bladder with resulting peritonitis. These organisms were not demonstrated in the cystic gland or in the submucosa.

B. coli appeared in the bile in only 3 cases, in each instance associated with multiple stone formation and great fibrosis of the wall, indicating long-standing disease. In no instance was *B. coli* recovered from the submucous coat, and, in the one case in which it was isolated from the cystic gland, contamination by bile could not be excluded. The occurrence of *B. welchii* has already been explained.

In 44 cases the bile was sterile, both in the presence and absence of stones, but in a few of these instances *B. coli* was found in the centre of calculi.

In spite of the sterility of the bile, streptococci were present almost always in the cystic gland.

Technique used for Cultures.—

Cystic Gland.—In order to obtain the best results in culturing the cystic gland, it was found necessary to follow a few simple but important rules. When removing the gall-bladder the cystic gland in each case was included. This presented no difficulty, for in the majority of instances it was enlarged and could be palpated or seen, even before the cystic duct was severed. A ligature was tied tightly around the distal end of the cut cystic duct to prevent any escape of gall-bladder contents. Keeping everything in a sterile condition, the cystic gland was carefully dissected, removed from the surrounding tissue, minced up finely with scissors, and placed in a tube of warm glucose broth. By dividing the gland into sections, as many tubes were used as desired. The broth containing the gland was then incubated for from four to six hours, after which time the tissue was removed from the medium. The latter was then re-incubated for from twenty-four to forty-eight hours. By trying various methods this was found to be the most efficient. The growth was often slow, being almost imperceptible in twenty-four hours apart from a very faint opalescence. Glucose broth, being simple to prepare and free from any cloudiness, was found to be more convenient than Rose-now's brain-tissue medium and quite as efficient. The latter, unless fresh and very carefully prepared, tends to be slightly opalescent at the bottom of the tube, and thus an early growth is difficult to recognize.

If the gland tissue was not removed in a few hours, the final growth appeared to be less abundant and the organisms tended to die, probably owing to the action of toxic products from autolytic changes in the lymphoid tissue. If the growth, even though slight, was subcultured in glucose broth, at the end of twenty-four hours an abundant culture of streptococci resulted. The growth tended to settle to the bottom, and with gentle movement of the tube was seen to rise in a cloudy white adherent mass. This or the original growth was used for further investigation, for a single subculture did not appear to alter the reactions or virulence of the organism. Further subcultures seemed, on the other hand, to be unsatisfactory unless they were grown on agar slants.

On stained smears the streptococci appeared mostly in short chains (Fig. 343), provided that the cultures were made by the method laid down. Occasionally they existed in diploid form, were medium-sized, and produced smooth, non-hæmolytic, whitish colonies on blood-agar. The streptococci

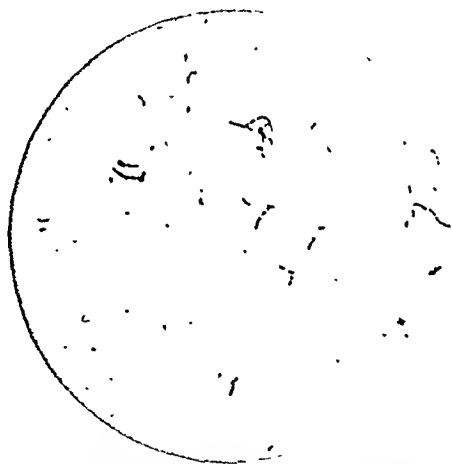


FIG. 343.—Appearance of streptococci isolated from the cystic gland growing in glucose broth.

from the bile, on the other hand, tended to be slightly larger and produced colonies of a distinctly rougher type. Although sugar reactions in streptococci appear to be of doubtful value, it may be stated that in fresh cultures the cystic-gland strains ferment lactose, mannite, and salicin with great regularity, whereas the type isolated from bile ferments saccharose also.

Submucosa, Gall-bladder Wall, and Bile.—A similar technique was used in culturing the submucosa and outer coats, the gall-bladder wall in its entirety, and the bile. In dealing with the submucosa care was taken to strip the outer coats in order not to penetrate the mucous membrane; by scraping the stripped surfaces and mincing the outer coats reliable cultures were obtained. In dealing with the entire gall-bladder wall the mucous membrane, previously washed, was employed along with the remaining coats. Bile was cultured in the ordinary way. These various cultures were carried out in every case, and were handled by the same methods as those used for the cystic gland.

IMPORTANCE OF THE STUDY OF THE CYSTIC GLAND.

The growths obtained from the cystic gland have special interest, apart from the mere isolation of an organism. They point to the marked degree of lymphatic absorption from the wall of the gall-bladder when that organ is diseased. The method furnishes an accurate means of obtaining in pure culture organisms derived from the gall-bladder wall. It is noteworthy that in this series of observations, whenever organisms were found within the wall, similar bacteria were isolated from the gland. This method obviates the difficulty of separating intramural organisms from any which may be growing in the lumen of the gall-bladder. The latter represent, it would appear, a secondary infection, remain solely in the lumen of the gall-bladder, are not found in the lymphatic drainage of the part, and are therefore in all probability of minor importance.

In reviewing this series, and many other cases of cholecystitis which have come to operation in Professor Wilkie's clinic, gross changes in the cystic gland have been noted. In normal gall-bladders this gland was rarely palpable and seldom seen. In early gall-bladder disease showing a mild degree of thickening, with or without the presence of a stone, the gland invariably showed definite enlargement. It was easily palpable, enlarged perhaps to the size of a small bean, and could be readily exposed. At this stage streptococci were always found in culture. In cases of more advanced cholecystitis the gland was more difficult to find, and in some cases was completely hidden by the effects of advanced disease.

The microscopic appearances in early cases were those of a lymphoid hyperplasia; in later cases fibroid changes predominated.

EXPERIMENTAL PRODUCTION OF CHOLECYSTITIS BY INJECTION OF STREPTOCOCCI ISOLATED FROM THE CYSTIC GLAND.

In attempting to prove the bacteriological etiology of any disease it is necessary to reproduce the identical gross and microscopic pathological changes by the injection of the particular organism into previously normal animals.

This procedure has been adopted in regard to organisms isolated from the cystic gland, and the results obtained have been quite striking in nature. Fresh agar cultures of streptococci isolated from the cystic gland (draining diseased gall-bladders) were suspended in saline (about 250 million per c.c.). These suspensions were used for injection purposes. Rabbits were the animals chosen to work with, as they were found to be the most convenient, especially when repeated intravenous injections had to be given. Control experiments were carried out in all cases.

The experiments may be broadly grouped under five headings: (1) Injection of streptococci directly into the lumen of the gall-bladder; (2) Injection of streptococci directly into the gall-bladder wall; (3) Injection of streptococci directly into the gall-bladder wall with the cystic duct occluded; (4) Intravenous injection of streptococci; (5) Intravenous injection of streptococci with the cystic duct occluded.

1. Injection of Streptococci Directly into the Lumen of the Gall-bladder.

—When streptococci isolated from the cystic gland were introduced into the lumen of the rabbit's gall-bladder, no changes whatsoever resulted. Within a very short time the bile was again found to be sterile. The gall-bladder wall remained in its normal state, and no lesions were demonstrated in any other organ. Similar negative results were obtained when streptococci of the type isolated from bile were injected.

2. Injection of Streptococci Directly into the Gall-bladder Wall.

—In order to produce intramural pathological changes when streptococci were injected directly into the gall-bladder wall, it was found

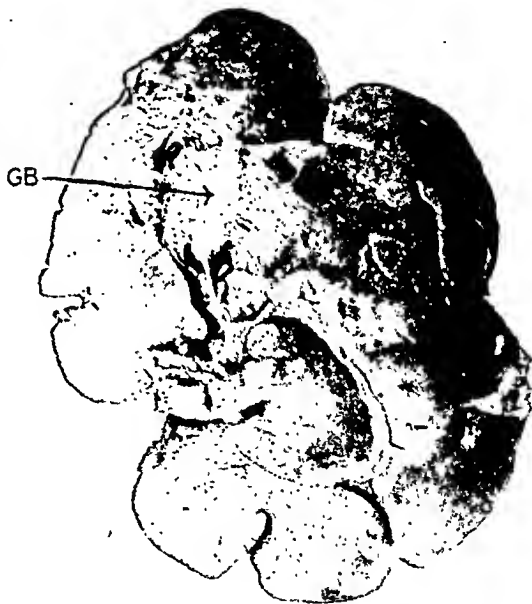


FIG. 344.—Photograph of rabbit's gall-bladder (GB) three months after direct inoculation with streptococci. Marked thickening of gall-bladder wall and cystic duct. Inflammatory processes invading surrounding liver substance.

necessary to exercise great care that the mucous membrane was not perforated. The fine folds of peritoneum covering the gall-bladder at its junction with the cystic duct formed the ideal site for injection. One to two minims of suspended streptococci were quite sufficient to produce marked changes. Animals so treated, when explored at the end of one week, presented very interesting and uniform features. At the point of injection, and for a short distance towards

the fundus of the gall-bladder, the wall appeared greyish-white and thickened. The cystic duct remained quite normal. These changes at the neck of the gall-bladder contrasted markedly with the fundus, which still appeared healthy. As a rule the gall-bladder was slightly more distended than normal, but the bile showed no visible change and was sterile on culture. At the end of a month the entire gall-bladder wall showed marked evidences of thickening, and was whitish and opaque in appearance. Radiating from the gall-bladder, small opaque thickenings were seen on the liver substance, and in one animal where repeated observations were made over a period of weeks these opaque inflammatory processes were seen to be spreading centrifugally from the gall-bladder.

When these animals were killed after a period of three months, the gall-bladder changes were most striking. The organ appeared as a tough, whitish, leathery pouch, uniformly and enormously thickened (probably eight to ten times its original thickness) by a gross production of inflammatory connective

tissue (*Fig. 344*). The mucous membrane was yellowish-white in appearance. The contents showed changes that seemed to vary with the amount of constriction of the gall-bladder outlet and the degree of change within the wall. In early cases, where changes were not marked, the gall-bladder was filled with rather thin bile mixed with a certain quantity of mucus. In more advanced cases the contents were mucopurulent, and as a general rule a few small pinhead-sized calculi were present. These

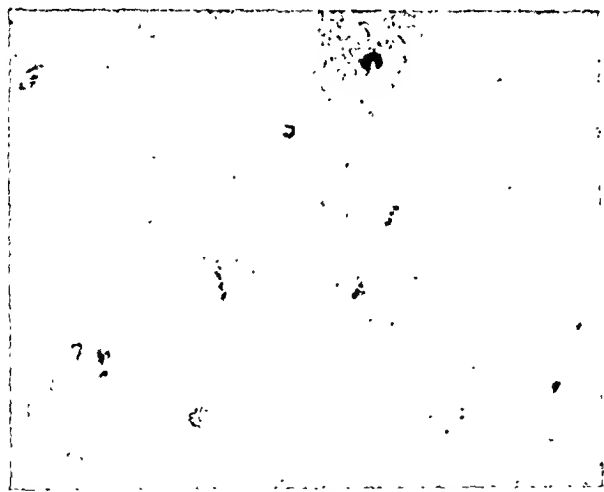


FIG. 345.—Streptococci in wall of rabbit's gall-bladder three months after direct inoculation.

stones were moderately hard, greyish-yellow in colour, and on chemical examination (Dr. I. S. Ravdin) were found to be made up of *cholesterin*, no *calcium* being present. No growth of any organism was obtained from the contents of the gall-bladders in this group of experiments, but the submucosa and outer coats, both in stained sections and on culture media, proved to be infected with streptococci of the same variety as those used in the original inoculation (*Fig. 345*). Histological examination showed an enormous increase in fibrous tissue in the submucosa and outer coats, with scattered areas of small round-celled infiltration (*Figs. 346-349*). An increase in the amount of fat was demonstrated in the submucosa by special fat stains. The mucosa showed an increase of lipid material, and the cells appeared *œdematous* and swollen.

Sections of the liver in the vicinity of the gall-bladder showed an

interlobular increase of fibrous tissue with round-celled infiltration, suggesting a chronic pericholangitis (*Fig. 350*). Areas of fatty infiltration of the liver substance were also frequently observed.

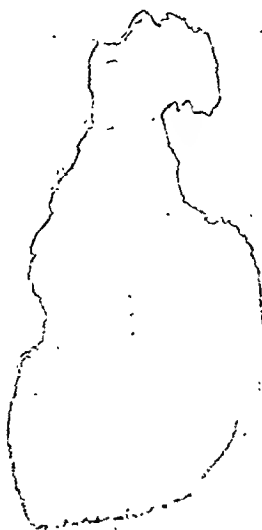


FIG. 346.—Very low-power microphotograph of a complete cross section of a normal rabbit's gall-bladder. The loss of mucous membrane in certain areas is an artefact. (Compare with *Fig. 347*.)



FIG. 347.—Very low-power microphotograph of a complete cross-section of a rabbit's gall-bladder three months after direct streptococcal injection. Note the enormous thickening due to fibrous-tissue production. (Compare with *Fig. 346*.)

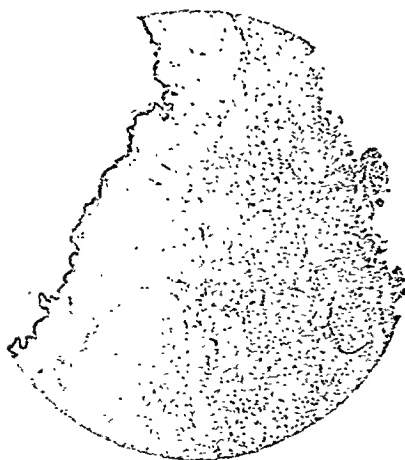


FIG. 348.—Ordinary low-power microphotograph of a portion of *Fig. 347*. Note scattered areas of inflammatory cells.

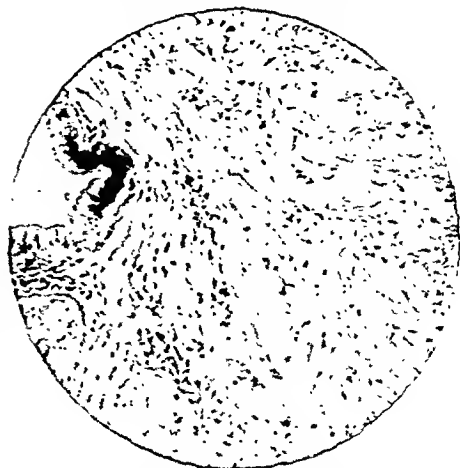


FIG. 349.—High-power microphotograph of a portion of *Fig. 347*. Note that thickening is due to inflammatory fibrous-tissue production, associated with inflammatory cell infiltration. A few strands of muscle fibres are shown. The mucosa is intact.

The remarkable fact in these experiments was the slow and progressive spread of the inflammatory process from a localized area at the point of inoculation throughout the entire wall of the gall-bladder. In one or two instances, where by accident some of the bacterial suspension escaped into the peritoneal cavity, little or no peritoneal reaction occurred.



FIG. 350.—Section of liver near site of infected gall-bladder of rabbit, showing interlobular fibrous-tissue production and inflammatory cell infiltration; chronic (productive) pericholangitis. The ducts are intact.

3. Injection of Streptococci Directly into the Gall-bladder Wall with the Cystic Duct Occluded.—

In this group of experiments the cystic duct was ligated, special care being taken not to include the cystic vessels, which in the rabbit lie in close proximity to the duct. The gall-bladder was allowed to remain filled with bile. Organisms were then injected into the gall-bladder wall as before.

The early changes were much the same as those in the preceding group of experiments, but the late results were quite different. The intramural changes were marked by generalized thickening, the result of fibrous-

tissue production, but the mucous membrane was paler, and the gall-bladder contained thick mucopurulent material with a great amount of granular debris appearing as fine sand and adhering to the mucous coat. The gall-bladder contents contained a great deal of this material, which had coalesced to form multiple soft calculi, and which on chemical examination contained a large amount of calcium as well as cholesterin. In several cases streptococci were isolated from the mucopurulent contents, but these organisms proved to be of a 'rougher' type than those employed for the original intravenous injections. The streptococci isolated from the outer coats of the gall-bladder corresponded in every way to those of the culture used for inoculation.



FIG. 351.—High-power microphotograph three months after direct injection of streptococci into the wall of a rabbit's gall-bladder, the cystic duct having been previously ligated. Note marked replacement of various coats by inflammatory fibrous tissue. Calcium and cholesterol stones were recovered from the lumen.

Histologically the gall-bladder wall showed marked replacement of the submucosa and outer coats by inflammatory fibrous tissue, associated with scattered areas of small round-celled infiltration (*Fig. 351*). The mucous membrane showed no noteworthy changes.

It should be noted that the only difference in technique between this and the preceding group of experiments was the occlusion of the cystic duct, which was carried out in this group and not in the former. Control animals with the duct ligated and sterile saline injected showed only an ordinary mucocoele of the gall-bladder. The wall and contents remained sterile, and no evidence of intramural inflammatory changes could be discovered. Any differences, therefore, in the results in these two groups of experiments must have been due solely to the effects of the occluded cystic duct. The main difference was found in the gall-bladder contents. In the preceding group the contents were sterile, and the calculi which formed were made up of cholesterol alone. In this group streptococci were often isolated from the mucopurulent material, and the stones which formed contained calcium as well as cholesterol. The intramural inflammatory changes were quite similar.

4. Intravenous Injection of Streptococci.—In dealing with intravenous injections of streptococci it was found that the most striking results were obtained when repeated doses were given at intervals. More than one injection, however (at approximately weekly intervals), produced marked changes in the gall-bladder wall. The average intravenous dose of streptococci given was 1.5 c.c. of a 250 million per c.c. suspension in saline. If, on injection into the ear vein of the rabbit, some of the suspension by accident entered the surrounding tissue, no local reaction resulted. As already stated, it was found very difficult to produce gall-bladder lesions with a single injection, but after two or more inoculations obvious changes were observed. These at first were characterized by an irregular whitish opacity of the gall-bladder, more marked in some areas than in others, and as a general rule a distention of the organ was seen. If the animals after a few injections were allowed to live two or three months, a typical chronic cholecystitis was found to have developed. This was characterized by a whitish leathery thickening of the entire wall, from the submucosa of which streptococci were recovered. The contents were often purulent, but proved sterile on culture. It was noticed, however, that the pathological changes produced by intravenous injection were much slower in developing than when the streptococci were introduced directly into the gall-bladder wall.

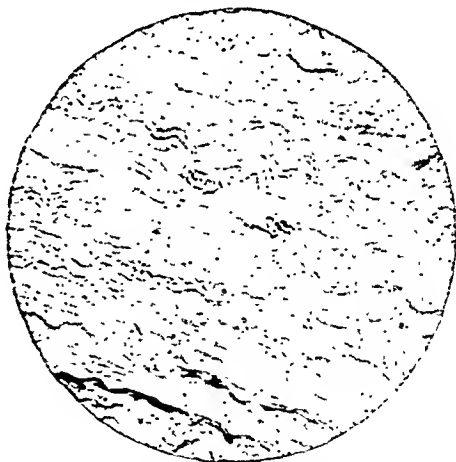


FIG. 352.—Microphotograph of streptococci in the wall of a rabbit's gall-bladder three months after intravenous injection of these organisms.

The histological mural changes were identical with those already described, and by the Gram method streptococci were demonstrated in the outer coats (Figs. 352-356). Calculus formation took place in several instances. The calculi contained only cholesterin with no trace of calcium.



FIG. 353.—Low-power photograph of wall of normal rabbit's gall-bladder. (Compare with Fig. 354.)



FIG. 354.—Low-power photograph of rabbit's gall-bladder three months after intravenous injections of streptococci. Note marked thickening and inflammatory cell infiltration. The mucosa appears intact. Compare with normal picture, Fig. 353.)



FIG. 355.—High-power microphotograph of a portion of Fig. 354. Note inflammatory cell infiltration, especially marked in the lamina propria mucosae. The outer coats have been replaced by fibrous tissue. The lumen contained one cholesterol stone.

The following experiment, which was typical of this group, supports Rosenow's contention that certain strains of organisms isolated from certain viscera have a selective affinity for those special organs.

A rabbit received an intravenous injection (into the ear) of 1.5 c.c. of a suspension of streptococci isolated from a cystic gland removed during cholecystectomy. The animal was explored each week in order carefully to observe the gall-bladder changes. The first inoculation produced no results. (This was found to be true of all animals, even after long periods of waiting, when only one inoculation was employed.) A second injection was given at the end of one week, and a few days later, when a laparotomy was done, early cholecystic changes were noted in the form of opaque thickenings at different locations in the gall-bladder wall. A few days after the third inoculation the changes had become more pronounced, the thickened areas appearing larger and tending to coalesce. The gall-bladder was slightly distended, and inflammatory processes were seen radiating from it and invading the neighbouring liver substance. The animal received six weekly doses, and on each exploration the lesions were seen to be more marked. Thickening of the wall progressed, and the inflammatory streaks proceeded farther along the liver surface.

At the end of ten weeks the animal was killed. The gall-bladder showed enormous thickening, contained one cholesterol stone, and was filled with purulent material, which on culture proved sterile. Streptococci were isolated from the outer coats. Histological changes were identical with those already described.

By such experiments the progress of the disease was carefully observed from week to week, and the factor of trauma was eliminated by similar operations on uninoculated control animals.

Positive results were obtained in every case after repeated intravenous injections. A point not without significance was the fact that after one intravenous injection little change could be detected in the gall-bladder, whereas after a second inoculation obvious changes were invariably found.

5. Intravenous Injection of Streptococci with the Cystic Duct Occluded (Figs. 357-360).—A similar technique was used in this group of experiments, but, in addition, in all animals the cystic duct was ligated previous to the intravenous injection. The cystic vessels were not included in the ligature.

The early changes were identical with those described under the preceding groups, except that the gall-bladder contained a great amount of mucopurulent material. When the disease reached an advanced stage, generalized thickening by fibrous-tissue production was observed throughout the gall-bladder wall. The contents proved to be mucopurulent, containing small calculi and sand-like granules as in the experiments of Group 3. The calculi and granules were rich in calcium but contained *relatively* little cholesterol. In one animal a streptococcus was isolated from the mucopurulent contents, in another *B. coli*; all others gave no growth. The gall-bladder submucosa and outer



FIG. 356.—High-power microphotograph of normal rabbit's gall-bladder. Note normal thickness of the wall under this power.

coats, both in stained sections and on culture, showed streptococci, corresponding in character to the original organisms injected. (The streptococcus previously mentioned isolated from the gall-bladder contents appeared, as in other cases, to be of a 'rougher' type.)

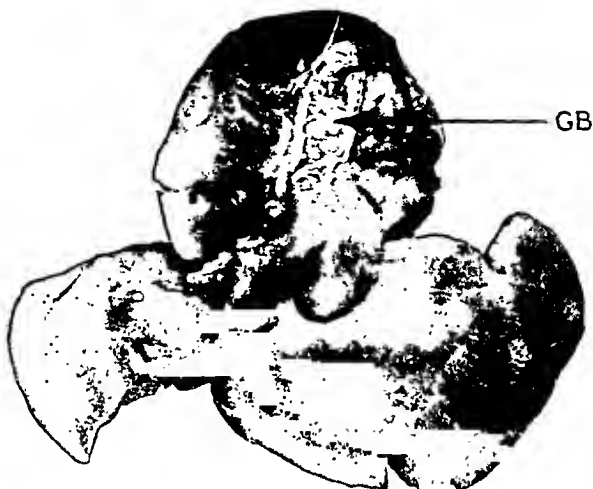


FIG. 357.—Photograph of rabbit's liver and gall-bladder (GB) three months after repeated intravenous streptococcal injections with the cystic duct tied. A portion of the gall-bladder wall has been removed to show formation of calculi made up of cholesterol and calcium. Note great thickening of the walls.

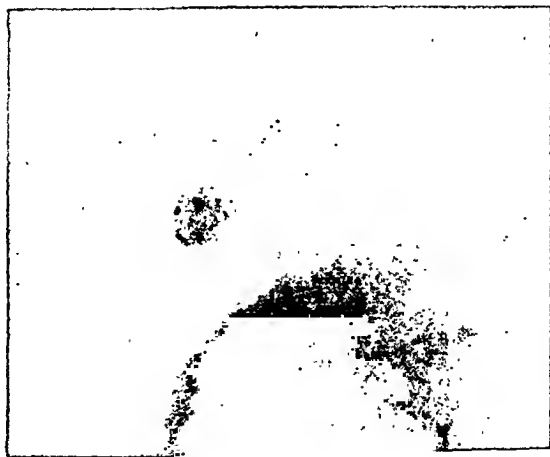


FIG. 358.—Skigram of rabbit's gall-bladder three months after intravenous streptococcal inoculation with the cystic duct ligated. Note presence of one large stone composed of calcium and cholesterol.



FIG. 359.—Actual drawing of rabbit's gall-bladder showing marked thickening of wall and formation of multiple stones composed of calcium and cholesterol. This lesion was produced by direct injection of streptococci. The duodenum shows a chronic ulcer.



FIG. 360.—Cholecystitis experimentally produced in gall-bladder of rabbit by injection of streptococci isolated from the human cystic gland. A portion of the fundus has been removed to show the interior of the gall-bladder and the enormous thickening of the wall.

The chief deduction to be drawn from this group of experiments was the fact that the streptococcus reached the gall-bladder by the blood-stream and caused similar intramural changes whether the cystic duct was occluded or patent. This fact was confirmed by modifications of these experiments.

In order to obviate the possibility of a lymphatic spread from the liver, as has been suggested by Graham,⁵ the gall-bladder was dissected from its liver bed, the only attachment remaining being the cystic vessels and the ligated cystic duct. A portion of omentum was then interposed between the gall-bladder and the liver. Following intravenous injections of streptococci, cholecystitis developed as in previous experiments. In this experiment the cystic artery was the only possible means of conveying the streptococcus to the gall-bladder wall.

CONCLUSIONS.

1. In the vast majority of cases of chronic cholecystitis in the human subject the bile is sterile on culture.

2. Cultures of the whole thickness of the gall-bladder wall most frequently give no growth.

3. Cultures from the submucous and outer coats leaving the mucosa intact have given a growth of streptococci in 42 per cent of cases.

4. Bile has been shown to inhibit the growth of this streptococcus.

5. The cystic gland in cases of cholecystitis has been shown to yield a growth of streptococcus in 86 per cent of cases.

6. *Bacillus coli* was recovered from the bile in only 6 per cent of cases. In the one case in which this organism was recovered from the cystic gland contamination by bile could not be excluded.

7. The streptococcus of cholecystitis is a short-chained type, produces smooth non-hæmolytic colonies on agar, and grows readily on glucose broth.

8. Injections of saline suspensions of this organism into the lumen of rabbits' gall-bladders produced no change.

9. Intramural injections of streptococci into rabbits' gall-bladders produced a progressive chronic cholecystitis, from which the organism was readily recoverable.

10. With the cystic duct ligated, intramural injections produced a chronic empyema with marked intramural changes.

11. Small calculi were produced with both types of intramural injection. When the cystic duct was ligated the calculi contained calcium and cholesterol; when the cystic duct was patent cholesterol only.

12. Intravenous injection of the streptococci, when repeated, produced a progressive chronic cholecystitis with the formation of cholesterol stones.

13. Intravenous injection after the ligation of the cystic duct produced an empyema of the gall-bladder with marked intramural changes and formation of granule-like calculi containing both calcium and cholesterol.

14. Separation of the gall-bladder from the liver, with interpolation of the omentum to exclude infection by lymph-spread from the liver, along with ligation of the cystic duct, did not prevent the development of cholecystitis when streptococci were injected intravenously.

15. The intramural pathological changes produced experimentally resemble in every detail the changes seen in the human gall-bladder in cholecystitis.

16. Cholecystitis would appear, therefore, to be a blood-borne streptococcic intramural infection.

I wish to express my thanks to Professor D. P. D. Wilkie, at whose suggestion and under whose guidance this work was carried out, and to Professor Edward Archibald, of McGill University, who granted and arranged my leave of absence from his service. I must also acknowledge the assistance rendered by the members of the technical staff of the Department of Experimental Surgery, University of Edinburgh.

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THE RESULTS OF SPLENECTOMY FOR PURPURA HÆMORRHAGICA.

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THE operation of splenectomy in the treatment of purpura hæmorrhagica was performed for the first time in 1916 by Kaznelson,³⁸ who argued that the hæmorrhages were the result of the constant reduction in the number of blood platelets, or thrombocytes, and that this reduction was brought about by the destructive action of a diseased spleen. He suggested the name 'thrombocytolytic purpura'. Frank²⁶ also advised splenectomy, but on different grounds—namely, that the reduction in platelets was due to an inhibitory action of the spleen on the bone-marrow, and for this reason called the disease 'essential thrombopenia'. As pointed out by Koster,⁴³ experimental evidence favours Kaznelson's view: "Were the platelets not formed in sufficient numbers, the amount of thromboplastic substance furnished to the blood by their destruction would be insufficient to cause prompt coagulation. The coagulation time, however, in this disease remains normal". Following in the wake of Frank and Kaznelson, many observers have performed splenectomy in the treatment of purpura hæmorrhagica, and have reported good results accruing therefrom. It is thought advisable, therefore, to report the following two cases in which splenectomy was performed: the one, in which there was no recurrence of hæmorrhages after a period of eight months; the other, in which splenectomy had no effect on their occurrence.

CASE REPORTS.

Case 1.—P. C., female, age 6, developed suddenly on Feb. 10, 1926, a purpuric eruption on the forehead, behind the ears, and on the trunk and limbs. The urine was bright red for three days, and she bled slightly from the ears. There was no disturbance of the general health. Three days later she had sudden and severe pain in the outer side of the right ankle, and four days after this she was admitted to the local hospital with a severe epistaxis, which lasted for three days. The pain in the leg proved to be due to acute osteomyelitis; the region was incised and pus evacuated; the sequestrum was discharged at the end of March, and the wound healed by the middle of June, 1926.

During the first week in May, 1926, there was a recurrence of the purpuric eruption, and petechiæ appeared in crops during May, June, and July. The distribution was as before, but there were also small hæmorrhages under the mucous membrane of the tongue and mouth. On Aug. 5 she had a mild epistaxis.

ADMISSION.—The patient was admitted into St. Bartholomew's Hospital on Aug. 6. She had always bruised easily since February, 1926. Her general health was good; there was no history of arthritis, abdominal pain, or melæna. There was no history of previous hæmorrhages; nor a family history of hæmophilia or purpura.

ON EXAMINATION.—There was a petechial rash over the trunk and limbs, and ecchymotic patches on the back and legs; there were petechiæ under the mucous

membrane of the mouth, and the mucous membrane around the teeth was vascular in places. The tonsils were enlarged, reddened, and had an active appearance; the tonsillar glands were enlarged; there were enlarged glands in the posterior triangles of the neck, in the axillæ, and groins. The heart and lungs were normal. The liver was palpable one finger-breadth below the right costal margin. The lower pole of the spleen was palpable on inspiration; it was firm and not tender. No hæmorrhages were seen in the fundi. There was no blood in the urine. The red blood-cells numbered 5,170,000 per c.mm.; hæmoglobin 70 per cent, making a colour index of 0.7. The white cells were 5200—of these, neutrophil polymorphonuclears, 3900; lymphocytes, 1090; large mononuclears, 155; eosinophil polymorphonuclears, 55. Blood platelets, 6450. Bleeding time, more than 30 min. (control, 2½ min.); coagulation time, 2 min. 17 sec. (control, 2 min. 15 sec). Wassermann and Sigma reactions were negative. A skiagram of the right fibula showed the presence of osteitis, but no sequestra.

At this time the case was considered to be an example of secondary purpura rather than of an 'idiopathic'. The primary foci suspected were the ankle-joint, although clinically it appeared perfectly sound, and the infected tonsils. On these grounds, therefore, it was decided to remove the tonsils, and in an attempt to lower the bleeding time in preparation for this, 15 gr. of calcium lactate were administered by the mouth three times daily. The petechiæ and ecchymoses, however, continued to appear, and on one occasion there was blood in the stools. After a month's treatment with calcium lactate, the patient was given 10 c.c. of horse serum subcutaneously on two occasions, still with no effect on the appearance of petechiæ and ecchymoses. The blood-count on Sept. 21 was: red blood-cells, 3,900,000; hæmoglobin, 68 per cent; colour index, 0.9; white blood-cells, 7200.

On Oct. 6 the patient was transfused with 50 c.c. of citrated blood: the bleeding time after this fell to 6 min. 40 sec. (control, 2 min. 10 sec.). On the following day tonsillectomy was performed, but the hæmorrhage was so great that only one tonsil could be removed; bleeding from the tonsillar bed continued for one and a half hours. The patient was discharged after three weeks, during which time she continued to have epistaxis and bleeding from the gums.

SECOND ADMISSION.—She was re-admitted on Nov. 2, 1926. During the first week there were three days on which she had severe epistaxis. The spleen was easily palpable. Examination of the blood gave the following results: red cells, 4,150,000; hæmoglobin, 55 per cent; colour index, 0.66; white cells, 9600—polymorphonuclears, 6672; lymphocytes, 1968; large mononuclears, 672; eosinophils, 288; platelets, 20,750; coagulation time, normal; bleeding time, 11½ min. (control, 3 min.).

On Nov. 24 the patient was transfused with 275 c.c. of citrated blood. Before transfusion the bleeding time was 5 min. 45 sec. (control, 1 min. 10 sec.); twenty-four hours after transfusion the bleeding time had fallen to 2 min. 30 sec. (control, 1 min. 15 sec.): the platelets had risen to 138,900; red cells, 4,630,000; white cells, 8600. Removal of the remaining tonsil was effected with practically no hæmorrhage at all. Forty-eight hours after transfusion the bleeding time had fallen to 1½ min. (control, 1 min.), and the platelets had risen to 173,200. Four days after transfusion, however, the bleeding time had risen to 14 min., and the platelets had fallen to 123,700; there was slight bleeding from the gums and lips during the night. After this there was no more bleeding, and the patient was discharged on Dec. 8 with a bleeding time of 14½ min., platelet-count, 154,300.

THIRD ADMISSION.—On Jan. 21, 1927, the child was admitted again with nose-bleeding and bruising. On examination she looked well; the tonsillar fossæ were clear. There were two large recent ecchymoses, one on the right forearm, one over the left great trochanter; there were many purpuric spots in all stages over the chest and abdomen; several old bruises were over both legs. The spleen was not palpable. Red cells numbered 4,580,000; hæmoglobin, 61.8 per cent; colour index, 0.68; white cells, 6200; platelets, 45,800; bleeding time, 15½ min. (control, 1 min. 15 sec.).

As no foci of infection were found, the previous foci having been treated successfully, and as the bleeding still continued, with constant diminution of platelets and

prolongation of the bleeding time, the case was considered one of essential thrombocytopenic purpura hæmorrhagica, and it was decided to perform splenectomy. On Jan. 31 the patient received a transfusion of 250 c.c. of citrated blood into the right internal saphenous vein. Eighteen hours after transfusion the platelets had risen to 115,200 and the bleeding time had fallen to $1\frac{1}{2}$ min. (control, 1 min.).

OPERATION.—On Feb. 1 splenectomy was performed by Professor Gask: the abdominal incision was attended by a good deal of bleeding, which was controlled with forceps; a splenunculus was found to be present, but was not removed. The platelet count two days after splenectomy had risen to 203,600; the bleeding time was 2 min. 7 sec. (control, 1 min.); red cells, 4,480,000; white cells, 7200—of these, polymorphonuclears, 3888; lymphocytes, 2016; large mononuclears, 1080; eosinophils, 36; basophils, 36; myelocytes, 36; abnormal vacuolated lymphocytes, 108.

The platelet-count showed the rise above normal which has been reported by several authors; on Feb. 7 the platelets were 344,600, and the bleeding time was 45 sec. On Feb. 17 they had fallen to 283,000, and the bleeding time to 40 sec.: red cells, 5,940,000; white cells, 10,000—of these, polymorphonuclears, 5750; lymphocytes, 2600; large mononuclears, 700; eosinophils, 450; transitional myelocytes, 450; myelocytes, 50.

AFTER-HISTORY.—The patient made an uninterrupted recovery, and eight months after the operation felt quite well and had had no hæmorrhages whatsoever. Four and a half months after operation there was, however, a slight flare-up of her osteomyelitis, which contributed probably to the leucocytosis which was found. The bleeding time at this period was 1 min. 7 sec. (control, 1 min.); platelets, 243,000; red cells, 4,860,000; white cells, 31,400—polymorphonuclears, 22,137; lymphocytes, 5338; large mononuclears, 3140; eosinophils, 785. Eight months after splenectomy the bleeding time was $\frac{3}{4}$ min. (control, $\frac{3}{4}$ min.); platelets, 400,000; red cells, 4,810,000; white cells, 14,000—polymorphonuclears, 7280; lymphocytes, 4830; large mononuclears, 770; eosinophils, 770; transitional, 210; basophil myelocytes, 140.

PATHOLOGICAL REPORT.—Mr. Geoffrey Keynes reported that the spleen which was removed at operation was somewhat enlarged: weight 117 grm. ($4\frac{1}{2}$ oz.). On section the lymphoid nodules appeared somewhat exaggerated, and contained large germinal centres of endothelial cells. There was an increase of the endothelial reticulum throughout, with diminution of lymphoid cells.

Case 2.—J. L., male, age 23, a clerk, had an attack of malaise, feverishness, and giddiness at Christmas, 1926; he was in bed for one day, and had a fairly severe epistaxis which lasted for two hours. Two months later a tooth was extracted, and the bleeding was so profuse as to necessitate plugging. Soon after this he became increasingly pale, weak, and short of breath on exertion; he had two or three slight epistaxes.

ADMISSION.—On April 30, 1927, the patient was admitted to St. Bartholomew's Hospital, complaining of increasing languor, dizziness, shortness of breath, and throbbing pains in the head. There was no history of respiratory or digestive disturbance, or of blood in the stools or urine; no history of previous hæmorrhages nor a family history of bleeding.

ON EXAMINATION.—The patient's expression was anxious, his skin and mucous membranes were very pale, with a very slight icteric tinge. There were small purpuric spots on the right arm, right shoulder, and front of the chest, and a few irregularly shaped hæmorrhages in both retinae. The tongue was clean, there was no gingivitis, and no hæmorrhages into the gums. The tonsils were slightly enlarged, but did not look septic; there was a little blood-clot at the back of the pharynx, but no obvious bleeding-point. The lungs were normal. The heart was over-acting, and a hæmic murmur was heard in the pulmonary area. The blood-pressure was 125 systolic, 75 diastolic. The liver and spleen were not palpable. There was no albumin or blood in the urine, and no blood in the faeces.

The red blood-cells numbered 1,337,000; hæmoglobin, 28 per cent; colour

index, 1.1; there were 2600 leucocytes—of these, polymorphonuclears, 845; lymphocytes, 1667; large mononuclears, 52; and myelocytes, 26; one normoblast was seen. There was marked anisocytosis and poikilocytosis, polychromatophilia, and hypochromasia; there was no punctate basophilia. Blood platelets, 38,000. The bleeding time was more than 12 min. (control, 2 min. 43 sec.), and the coagulation time 1 min. 20 sec. (control, 1 min. 39 sec.). Van den Bergh reaction on blood serum: direct, negative; indirect, 0.33 units. A fractional test-meal was normal and showed no hypochlorhydria.

On May 5 the patient had a severe epistaxis. The anterior nares were plugged with gauze soaked in 1-1000 adrenalin, and 3 c.c. of hæmoplastie serum and $\frac{1}{4}$ gr. of morphia were given subcutaneously. He bled for five hours and lost about 600 c.c. of blood. The blood-count was: red cells, 1,169,000; hæmoglobin, 23 per cent; colour index, 1.0; white cells, 2600. Differential: polymorphonuclears, 468; lymphocytes, 1950; large mononuclears, 156; myelocytes, 26. Owing to his severe anæmia he was given liq. arsenicalis hydrochlor. (3 minims) with an iron mixture containing 8 gr. of iron and ammonium citrate three times daily, and this was increased gradually until in three weeks he was taking 8 minims of the liquor daily.

On May 6 another profuse epistaxis occurred; the patient also vomited 16 oz. of clotted blood, which had probably trickled into his stomach from the nasopharynx. He was given 20 gr. of calcium lactate orally three times daily and transfused with 550 c.c. of citrated blood. On May 7 he was transfused with 450 c.c. of citrated blood. This was followed two hours after by a rigor, and the temperature rose to 103.2°, but fell again to normal by evening.

On May 12 a crop of petechiæ appeared on the right upper arm and chest. Blood-count: red cells, 1,659,000; hæmoglobin, 33 per cent; colour index, 1.0; white cells, 1800. Differential: polymorphonuclears, 288; lymphocytes, 1386; eosinophils, 18; large mononuclears, 72; myelocytes, 36. No normoblasts. Blood platelets, 38,000. Small crops of petechiæ continued to appear during the next four weeks.

On May 17 the red cells were 1,653,000; hæmoglobin, 33 per cent; colour index, 1.0; white cells, 1900. Differential: polymorphonuclears, 342; lymphocytes, 1502; large mononuclears, 57; platelets, 8250.

On May 25 the red cells were 1,680,000; hæmoglobin, 35 per cent; colour index, 1.03; white cells, 1600; platelets, 6800. The coagulation time was 1 min. 20 sec. (control, 1 min. 39 sec.); bleeding time more than 12 min. (control, 2 min. 42 sec.).

The administration of iron and arsenic alone had obviously failed to promote hæmoglobin and red-cell formation. On May 28, as a further attempt to effect this, the patient was put on a diet of 6 oz. of cooked liver daily, with excess of green vegetables and increased fat in the form of butter. On May 31 the red cells were 1,825,000; hæmoglobin, 31.5 per cent. On June 2 hæmoglobin, 28.5 per cent. On June 8 red cells, 1,536,000; hæmoglobin, 28.5 per cent.

No focal sepsis had been found; the tonsils appeared free from infection; the ears were normal; stool culture failed to reveal any hæmolytic coliform bacilli; one colony only of hæmolytic staphylococci was grown. This being the case, and as the bleeding time was greatly prolonged, the coagulation time normal, and the platelets considerably diminished, the diagnosis of idiopathic purpura hæmorrhagica was made.

OPERATION.—On June 11 the patient was transfused with 400 c.c. of citrated blood, and on the 15th splenectomy was performed by Mr. R. M. Vick. The operation was accompanied by a large amount of bleeding, which was controlled with difficulty; there was no diminution of bleeding after the splenic vessels had been clamped, a phenomenon which has been reported by several authors. During the latter stages of the operation the patient received a transfusion of 600 c.c. of citrated blood.

AFTER-HISTORY.—After splenectomy there was some improvement. On June 18 the platelets numbered 45,000. On June 22 the red cells were 2,000,000; hæmoglobin, 28 per cent; platelets, 96,480; but on the same day a profuse epistaxis

occurred. On the 28th the red cells had fallen to 1,570,000, the hæmoglobin being 32 per cent; platelets, 47,000. On Aug. 7 the platelets were 48,000, and the bleeding time had fallen to 4 min. 25 sec. (control, 3 min. 28 sec.).

On July 30 the administration of iron and inorganic arsenic was discontinued, and on Aug. 7 organic arsenic was given in the form of $\frac{3}{4}$ gr. of sodium cacodylate subcutaneously twice daily. There was no improvement in the blood picture; slight attacks of epistaxis and the appearance of petechiæ continued, and on Aug. 13 there was a large hæmorrhage into each retina. The patient was transfused again with 550 c.c. of citrated blood, but without improvement: the red cells numbered 1,200,000; hæmoglobin, 30 per cent; platelets, 16,000. On Aug. 25 there was bleeding from the gums for three hours, and on the 27th another transfusion of 550 c.c. of citrated blood was given. On the 28th acute tonsillitis ensued which was treated with an autogenous vaccine. The patient is still (Oct. 12, 1927) in hospital with occasional bleeding from the gums, slight attacks of epistaxis, and crops of petechiæ.* On Sept. 28 the red cells were 1,570,000; white cells, 1800; platelets, 43,600; and bleeding time was more than 15 min. (control, 1 min.).

PATHOLOGICAL REPORT.—Dr. Conway Davies reported that the spleen which was removed at operation was somewhat enlarged. On section it appeared normal. Microscopically, it was normal except for hyaline degeneration in the walls of the arteries; there was no endothelial proliferation and no increase of the lymphoid nodules. In a smear of the cut surface of the spleen there were 200,000 platelets per c.mm.

DIAGNOSIS.

Purpura may be produced by such a large number of causes that all of these must be eliminated before a definite diagnosis of purpura hæmorrhagica is made. Prolongation of the bleeding time, diminution of the platelet-count, and normal coagulation time occur in secondary purpura as well as in primary, so that all foci of infection should be carefully hunted for, and the condition considered a secondary purpura until this is definitely disproved. In *Case 1* the appearance of purpuric spots was more or less synchronous with the onset of osteomyelitis of the right fibula, and it was thought at first that the continuation of purpuric symptoms might be due to some remaining sepsis in this bone. Moreover, the tonsils were infected, and the occurrences of hæmorrhages after the leg appeared clinically sound caused suspicion to be centred on them. These were consequently enucleated, but still hæmorrhages continued, although all foci of infection had been removed. On these grounds, therefore, the case was considered one of essential thrombocytolytic purpura hæmorrhagica.

The diagnosis of *Case 2* was for some time in doubt. Diminution of blood platelets does not label a condition one of purpura hæmorrhagica, as considerable diminution occurs in pernicious anæmia, aplastic anæmia, and lymphatic leukæmia,¹⁸ though not perhaps to such a marked degree. In this case there was severe anæmia, leucopenia with relative lymphocytosis, and

* The patient died in November 1927, while this paper was in the press. At autopsy, the pericardial sac contained 4 oz. of clear serous fluid. There were many hæmorrhages under the parietal and visceral pericardium. The heart muscle showed marked fatty degeneration. Each pleural cavity contained 6 oz. of clear serous fluid; there were dense adhesions between the upper and middle lobes, and a few subpleural hæmorrhages were present. Both lungs were extremely œdematous, and were studded throughout with small intrapulmonary hæmorrhages. The liver showed fatty degeneration and a feeble Prussian-blue reaction. The kidneys were fatty, and the Prussian-blue reaction was negative; both pelves showed areas of extensive hæmorrhages. The bone-marrow from the middle of the shaft of the left tibia was extremely pale; the Prussian-blue reaction was negative.

an absolute decrease of polymorphonuclears, and a considerable diminution of platelets. The question arose whether it was an example of aplastic anæmia or purpura hæmorrhagica; there is no definite dividing line between the two conditions, but the one runs imperceptibly into the other. The deficiency of platelets is supposed to account for the hæmorrhagic tendency shown in aplastic anæmia. Of myelophthisic conditions giving rise to such a blood picture, Frank²⁵ recognizes three degrees:—

1. *Intermittent thrombopenia*, in which there are occasional recurrent attacks of hæmorrhages. It occurs mainly in children, and includes those conditions variously known as peliosis rheumatica, Henoch's purpura, etc. Frank states that before the onset of the hæmorrhages there is a diminution in the platelet-count, though between the attacks it is normal.

2. *Essential thrombopenia, or purpura hæmorrhagica*, in which there is always a continuous reduction of platelets, usually an anæmia, and often a leucopenia of varying degree with diminution in polymorphonuclears both relative and absolute.

3. *Leukia hæmorrhagica, or aplastic anæmia*, in which the anæmia and leucopenia of (2) are accentuated.

It cannot be said definitely that this is a case of purpura hæmorrhagica, but the simultaneous occurrence of the marked prolongation of the bleeding time, the considerable diminution in the number of platelets, and the normal coagulation time favours this view.

MORBID ANATOMY OF THE SPLEEN.

The findings in *Case 1* agree with those of most observers, who have found that the majority of spleens removed from patients with purpura hæmorrhagica show hyperplasia of the endothelial phagocytes. In the present review the reports of twenty-seven of such spleens are collected. The spleens in most cases are enlarged to two or three times their normal size and contain a large amount of blood. On the whole, the most striking changes are marked endothelial proliferation of the Malpighian bodies and sinuses. There is an increase in the number of reticular cells in the sinuses and throughout the entire organ. In some cases there is an infiltration of polymorphonuclears and eosinophils. The number of lymphoid cells varies; it may be normal, increased, or diminished.

Hitzrot³⁷ has reported a case in which the arteries in the follicles showed almost uniformly a thickening and hyaline degeneration of the wall and narrowing of the lumen; in *Case 2* here reported there was similar hyaline degeneration in the walls of the arteries. In two cases published by Sutherland and Williamson,⁷³ in addition to endothelial proliferation, the connective tissue of the sinuses was swollen and hyaline, and the lymphocytes were greatly diminished. Most observers could find no collections of platelets, but Benecke,⁷ Cori,¹⁵ Giffin,²⁸ and Minkowski⁵³ have each reported cases in which many platelets were in evidence—many were present in a smear of the spleen in *Case 2* of this paper. In one of Sutherland's cases,⁷³ a lymph gland removed from the mesentery at the time of operation showed also marked endothelial proliferation. Giffin and Holloway,²⁹ in a review of twenty-eight cases, found nothing of outstanding importance, except the presence of an

abnormally large number of neutrophil polymorphonuclears. They suggest that the splenomegaly of purpura hæmorrhagica is an acute splenitis.

THE RELATION OF PLATELETS TO THE BLEEDING TIME.

By studying the behaviour of the bleeding time in *Case 1*, it will be seen that its decrease or increase is associated with the rise or fall of the platelets, and from this it may be concluded that the tendency to prolonged bleeding is due, at least in part, to the deficiency in platelets. Duke¹⁹ has shown that a diminution in the platelet-count is associated with prolongation of the bleeding time, though the actual clotting time remains normal. Sutherland and Williamson⁷³ state that when the platelets reappear in sufficient number in the blood, for instance, after splenectomy, the bleeding time becomes normal. From a survey of the literature, however, I have found that diminution in the number of platelets is not necessarily associated with prolongation of the bleeding time (*Table I*). It may be argued that the platelets in *Group A* of the table are in sufficient numbers for the bleeding time to be normal, but

Table I.—RELATION OF PLATELETS TO THE BLEEDING TIME.

| NO. OF CASE IN ABSTRACT | TIME AFTER OPERATION | PLATELETS | BLEEDING TIME |
|---|----------------------|-----------|---------------|
| <i>Group A.</i> —Platelets diminished and bleeding time normal after splenectomy. | | | |
| 1 | 4½ months | 60,000 | 1 min. |
| 4 | 11 weeks | 12,000 | 3 " |
| 5 | 2 hours | 31,200 | 3 " |
| 5 | 6 weeks | 12,000 | 3 " |
| 9 | 8 months | 20,000 | 2 " |
| 9 | 14 months | 120,000 | 2 " |
| 11 | 15 hours | 109,000 | 3 " |
| 41 | 1 day | 20,000 | ½ " |
| 49 | 18 days | 88,000 | 2½ " |
| 93 | 10 months | 20,000 | Normal |
| 6 | 2 days | 80,000 | 3 min. |
| 97 | 6 days | 100,000 | 1½ " |
| <i>Group B.</i> —Platelets normal or increased, bleeding time increased. | | | |
| 9 | 10 months | 200,000 | 16-20 min. |
| 24 | (Before splenectomy) | 284,000 | 33 " |
| 34 | " After operation " | 600,000 | 5 " |
| 50 | 5 days | 516,000 | 7½ " |
| 60 | 8 days | 250,000 | 5 " |
| 88 | 3 days | Normal | 7 " |

Table II.—PLATELETS AND BLEEDING TIME IN PERNICIOUS ANEMIA.
(After Buckman and Hallisey¹⁰).

| PLATELETS | BLEEDING TIME |
|-----------|---------------|
| 32,000 | 3¼ min. |
| 172,000 | 3¼ " |
| 160,000 | 4¾ " |
| 101,000 | 1¼ " |
| 171,000 | 2¼ " |
| 53,000 | 3 " |
| 110,000 | 2½ " |
| 97,000 | 3¼ " |
| 148,000 | 3 " |

on the other hand from the abstract of 101 cases given in the APPENDIX (see p. 480) it will be seen that a greater number of platelets than those in Group A may be associated with a prolonged bleeding time.

In Group A of Table I the platelets are diminished and the bleeding time is normal, and no hæmorrhages occurred after splenectomy in these cases except in No. 8. Moreover, in pernicious anæmia there is a diminution in the number of platelets, and yet the bleeding time is normal or but very slightly prolonged (Table II). Further, Roskam⁶⁶ has shown experimentally that in animals in which a marked reduction of the platelet-count had been produced by the intravenous injection of a solution of gelatin, the bleeding time was only slightly prolonged. In Group B of Table I there are cases in which there is a normal or an increased number of platelets, and yet the bleeding time is prolonged. These facts seem to show that prolongation of the bleeding time is probably dependent on something more than platelet reduction, perhaps on a qualitative defect in the platelet itself. This aspect of the problem requires further investigation. In support of this view that abnormal platelets may be the cause of prolonged bleeding time, Rockwood and Sheard⁶⁴ have demonstrated in purpura hæmorrhagica by instantaneous microphotography a structural change in the platelets which is not demonstrable in other diseases, such as pernicious anæmia.

THE EFFECT OF CITRATED BLOOD ON THE BLEEDING TIME AND PLATELETS.

The status of blood transfusion was discussed a few years ago in an editorial of the *Journal of the American Medical Association*,²⁰ in which the writer concludes that citration of the blood causes destruction of blood platelets, that sodium citrate has, in itself, a toxic effect, and that the giving of citrate in transfusion lowers the hæmostatic power of the circulation. These statements are supported by Herr,³⁵ who says that the citrate solution destroys the platelets, which are necessary for maintaining the blood at its highest efficiency, and that as the platelets are destroyed, toxic by-products are liberated into the plasma with deleterious after-effects. Burke and Tait¹¹ consider that the only blood elements concerned in the spontaneous coagulation of mammalian blood are the platelets. Giehner²⁷ has shown that platelet-free mammalian plasma will not spontaneously clot under circumstances that cause coagulation of platelet-rich plasma, that sodium citrate in sufficient concentration inhibits their activity completely, but that if sufficient concentration of a calcium salt is added, or the concentration of citrate is sufficiently lessened, platelets behave as in unmodified blood, thus refuting the above statement that platelets are destroyed by citrate. Giehner, however, in two cases of pernicious anæmia and three of secondary anæmia, in which transfusion of citrated blood was performed, was unable to find any marked rise or fall in the platelet-count as a result.

In Case 1 of this paper transfusion with citrated blood was performed on three occasions: on the first with 50 c.c. of blood containing 1 grm. of sodium citrate, on the second and third with 275 c.c. and 250 c.c. respectively, each amount containing 2 grm. of sodium citrate. On the first occasion the bleeding time four days before the transfusion was more than 30 min.; eight

days after, the bleeding time had fallen to 6 min. 40 sec.; the platelets were not counted. Before the second transfusion the platelets numbered 20,750, and the bleeding time was $5\frac{3}{4}$ min.; twenty-four hours after the transfusion, the platelets were 138,900, bleeding time $2\frac{1}{2}$ min.; forty-eight hours after, the platelets were 173,200, bleeding time $1\frac{1}{2}$ min.; four days after, however, the platelets were 123,700, bleeding time 14 min. Before the third transfusion the platelets were 45,800, and bleeding time was $15\frac{1}{2}$ min.; eighteen hours after, the platelets were 115,200, bleeding time $1\frac{1}{4}$ min. (Fig. 361). This

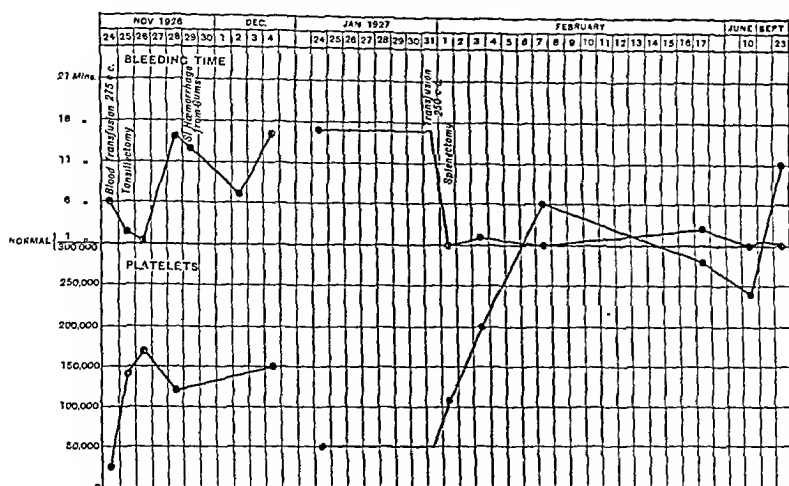


FIG. 361.—Chart showing the effect of blood transfusion and splenectomy on the bleeding time and platelet-count in purpura hæmorrhagica (Case 1).

disproves the statement that platelets are destroyed by citrated blood and that the hæmostatic power of the blood is reduced by citrate. It seems that transfusion acts as a temporary stimulus to the megakaryocytes of the bone-marrow to increased platelet production, but that after three or four days this stimulating effect disappears, with consequent diminution of the platelet-count and prolongation of the bleeding time.

In Case 2 repeated blood transfusions were performed with no effect on the blood picture whatsoever, a possible explanation being that the marrow was too diseased to respond.

THE EFFECT OF SPLENECTOMY.

Case 1 illustrates the beneficial effect of splenectomy in this disease which has been reported by many writers. Immediately after operation there was cessation of hæmorrhages, with no recurrence for eight months; the bleeding time fell to normal and has remained so; the platelets rose gradually to a high level, and six days after the operation were above normal; the high platelet-count was maintained, and eight months after was well above normal. In Case 2 the result of splenectomy was poor. There was some slight improvement, for after the operation the patient did not have the severe attacks of epistaxis from which he suffered previously, but bleeding still continued as

crops of petechiæ, slight attacks of epistaxis, and hæmorrhages from the gums and into the retinae. The platelets rose a little after the operation and the bleeding time fell to $4\frac{1}{2}$ min., but this improvement was not maintained.

From the analysis of 101 published cases (*see* p. 480) of purpura hæmorrhagica in which splenectomy was performed, it is found that a good result with no recurrence of hæmorrhages occurred in 69, and in 6 cases there was considerable improvement; 21 died after operation, while in 5 the hæmorrhages continued with but slight improvement. Of the 75 cases in which the result was good, 16 were not followed up for any considerable period, so that little value can be attached to these. Of the 21 fatal cases, 17 died as the result of severe bleeding: in Corpus' case (No. 13) there were hæmorrhages into the endocardium, pericardium, and stomach; in Engel's (No. 17) into the skin and serous cavities; in Engel's second case (No. 18) there were hæmorrhages into the gastro-intestinal tract, genito-urinary tract, and heart; in Herrman's case (No. 33) there were subcutaneous, subserous, and parenchymatous hæmorrhages; in one of Kaznelson's (No. 38) marked degeneration and bleeding into the myocardium; in two cases, Peterson's (No. 62) and Singleton's (No. 78), there was cerebral hæmorrhage; and in Starr's (No. 81) massive clots were found over both cerebral hemispheres beneath the dura. Four cases died of causes other than those due to purpura hæmorrhagica: one death was accidental during operation; in Cori's case (No. 12) malarial parasites were found in the blood, and death occurred from subphrenic abscess one month after operation; Henrahan's case (No. 31) died one month after operation, and at autopsy abscesses were found in the lungs, myocardium, and kidneys; Rixford's case (No. 66) developed acute myeloid leukaemia two months after operation, and died two months later.

The histories of these 101 cases show that purpura hæmorrhagica may be divided into the acute and the chronic type (*Table III*), the chronic being much more common than the acute: there were 80 chronic, 12 acute, and 9 cases in which the duration of the hæmorrhages was not stated. Out of the 12 acute cases 10 died, but of the chronic only 8, one being due to an accident and 3 to causes other than purpura hæmorrhagica; in 5 of the chronic the result was poor. Thus it appears that splenectomy is much more suitable for the chronic type of case than the acute.

Table III.—RESULTS OF SPLENECTOMY IN 101 CASES OF PURPURA HÆMORRHAGICA.

| RESULTS | ACUTE | CHRONIC | UNCLASSIFIED | TOTAL |
|---------------------------|---------------|---------------|--------------|---------------|
| <i>Good results</i> | | | | |
| No recurrences | 2 | 61* | 6† | 69 |
| Improvement | — | 6 | — | 6 |
| | Per cent 16·6 | Per cent 80·3 | | |
| <i>Poor results</i> | — | 5 | — | 5 |
| <i>Deaths</i> | 10 | 8 | 3 | 21 |
| | Per cent 83·3 | Per cent 11·5 | | Per cent 20·8 |
| Total cases | 12 | 80 | 9 | 101 |

* 12 cases with no follow up. † 4 cases with no follow up. ‡ Excluding those not followed up.

The effect of splenectomy on the platelet-count varies considerably. In 61 cases there was a great increase, the count rising to normal in 25, and above normal in 36, but in 35 of these 61 cases counts were not made over a period of more than three months after splenectomy, so that it is impossible to say what happened ultimately. In 11 of these 35 which were not followed up, however, the count had fallen from above normal to normal by the end of three months. Of the 26 cases which were followed up, in 10 the platelet-count remained normal over a considerable period, and in 16 the platelets fell gradually so that there was again a thrombocytopenia. In those in which a high count was maintained no hæmorrhages occurred, with one exception. Keisman's case (No. 40), in which the result was poor in spite of the normal platelet-count. Of the 16 in which an initial rise was followed by a thrombocytopenia, 11 had no recurrence of hæmorrhages, 1 improved, in 1 the result was poor, and 3 (Nos. 12, 47, and 78) died. In 17 cases splenectomy was followed by little or no increase in platelets, and of these 7 (2 of which were not followed up) had no recurrence of hæmorrhages, 2 were improved, 2 continued to bleed, and 5 died. Thirteen cases died before any investigations were made, and in 12 there were no details. In all cases, except those mentioned in *Table I*, the rise or fall in platelets was associated with a fall or rise in the bleeding time.

The blood picture after splenectomy shows, according to Noguchi,⁵⁹ a diminution in polymorphonuclears and a lymphocytosis during the first year; later the lymphocytes fall to normal and there is an eosinophilia; and later still the count is normal. Of the two cases published in this paper the first showed a rise in erythrocytes sixteen days after the operation and a subsequent fall to normal; there was a moderate leucocytosis with an increase in all cells, but four and a half months after, the leucocytosis had become considerable owing to a great increase in polymorphonuclears, which was accounted for by the recurrence of osteomyelitis. Eight months after, the leucocytosis was again moderate, the increase being general. In *Case 2* there was no marked change in the blood picture except for a slight temporary rise of erythrocytes. Thursfield and Gow,⁷⁴ from an analysis of 100 cases of splenomegaly from which the spleen was removed, conclude that the immediate result is an increase in erythrocytes and a leucocytosis which returns gradually to normal, there only being a tendency to the findings of Noguchi. From the present review the conclusion is similar: splenectomy is followed by an immediate rise of erythrocytes and a leucocytosis with a normal proportion of cells, followed in most cases by a very gradual fall.

The questions arise why some cases are benefited by splenectomy and others are not; and why in some cases splenectomy causes a permanent increase in platelets, in others an increase followed by a decrease, and in others no increase at all. They can be answered only by a study of the pathogenesis of the condition. The constant decrease in platelets suggests that they play a part in the causation of the hæmorrhages, and Duke¹⁹ expressed the view that the essential factor in primary purpura is an abnormal permeability of the endothelium of the small vessels, and that the function of the platelets is to adhere to such permeable sites, and prevent the escape of blood. In so doing the platelets are withdrawn from the circulation. Tidy⁷⁵ considers

that the deficiency of platelets may be due directly to the bone-marrow not replacing sufficiently the losses due to hæmorrhage, and concludes that reduction in the number of platelets is a secondary phenomenon. Were this the case, one would expect them to be reduced in secondary anæmias. Crawford,¹⁸ however, states that the platelet-count in secondary anæmias is normal or increased, and this agrees with the findings of Buckman and Hallisey.¹⁰ Moreover, from the blood-counts in purpura hæmorrhagica (*Table IV*), it is evident that the diminution in platelets far exceeds the diminution in red cells—a state of affairs which one would not expect were the thrombocytopenia due to a secondary exhaustion of the bone-marrow. From this it appears that the diminution of platelets is not a secondary phenomenon, but a primary factor in the causation of the disease.

Table IV.—BLOOD-COUNT IN PURPURA HÆMORRHAGICA.

| CASE No. | Hb% | R. B. C. (in thousands) | PLATELETS | CASE No. | Hb% | R. B. C. (in thousands) | PLATELETS |
|----------|-----|----------------------------|-----------|----------|-----|----------------------------|-----------|
| 1 | 60 | 5,200 | 11,000 | 59 | 60 | 6,504 | 60,000 |
| 12 | 40 | 4,200 | 2,700 | 60 | 55 | 5,554 | 0 |
| 17 | 76 | 4,500 | 0 | 65 | 78 | 4,940 | 70,000 |
| 23 | 55 | 4,400 | 62,000 | 79 | 70 | 5,170 | 6,450 |
| 29 | ? | 4,200 | Few | 83 | 87 | 4,620 | 62,600 |
| 33 | 61 | 3,700 | 30,000 | 84 | 85 | 4,120 | 36,000 |
| 37 | 120 | 5,500 | 6,700 | 85 | 50 | 5,300 | 18,000 |
| 52 | 73 | 4,480 | 52,000 | 86 | 45 | 5,200 | 5,000 |
| 54 | 60 | 4,500 | 3,000 | 89 | 75 | 4,000 | Very few |
| 55 | 56 | 5,200 | 14-29,000 | 96 | 65 | 4,200 | 0 |
| 58 | 42 | 4,980 | 0 | 97 | 75 | 4,400 | 5,000 |

Ledingham and Bedson¹⁷ have produced in guinea-pigs by the injection of anti-guinea-pig-platelet serum a condition resembling purpura hæmorrhagica, but sera prepared against other blood elements were unable to produce purpura. The characteristic feature in the purpuric animals was the early and extensive fall in the number of platelets; sera other than anti-platelet sera produced little or no change in this respect. Bedson³ has shown, however, that reduction of platelets is not the only factor. By injecting intravenously into guinea-pigs substances such as 'agar serum' or peptone he produced a considerable, though transitory, fall in the platelet-count, and yet there were no hæmorrhages. He suggested that the second factor was damage to the capillary endothelium, and he reasoned that if this was so, then it should be supplied by any of the sera prepared against the blood elements, since they are all more or less closely related genetically to the endothelial cell. Anti-red- and anti-white-cell sera were unable to produce purpura, presumably because they did not remove the platelets from the circulation; anti-platelet serum effected it because it is in anti-platelet serum alone that the two factors are combined. When anti-red-cell serum was inoculated into a rabbit to damage the endothelium, and shortly afterwards agar serum to remove the platelets, purpura was produced, the post-mortem findings being similar to those produced by anti-platelet serum. If the function of platelets is to

adhere to any permeable site in the vessel wall and prevent the escape of blood, damage to the endothelial wall will not cause purpura, because the platelets conglutinate over the damaged area and block the stoma. When both platelets and endothelium are affected, there are not sufficient platelets to block all the stomata, and hæmorrhages result.

It has been shown (Bedson and Johnston⁶; Alnitz, Norbell, and Piette¹) that in all probability one of the functions of the spleen is the destruction of blood platelets. In some cases of purpura hæmorrhagica in which splenectomy has been performed, after the preliminary increase in the number of platelets, there is a fall to normal, and later the diminution continues until the thrombocytopenia is almost as severe as before splenectomy. This is suggestive that the function of destruction of platelets is being vicariously performed by other cells in the body. This has also been shown experimentally by Bedson.⁴ Splenectomy in a normal guinea-pig was followed by a great increase in the platelet-count, which was almost doubled in two days. In three or four weeks the count had fallen to normal. The spleen forms part of the reticulo-endothelial system, and Bedson⁵ has shown experimentally that the system plays probably a part in the regulation of the number of platelets. The endothelial cells can be so packed with particulate matter, such as trypan blue, carbon, and colloidal silver, as temporarily to upset their functions. By 'blockading' the reticulo-endothelial system of normal rabbits in this way Bedson produced a transitory rise in platelets similar to that obtained after splenectomy. If splenectomy was performed on such an animal, there was no further increase of platelets. Blockade of the reticulo-endothelial system in a splenectomized animal in which the platelet-count had fallen to normal again, resulted in a rise in the count comparable to that obtained by 'blockading' the animal before removal of the spleen. He concludes from this that in the absence of the spleen the maintenance of the platelet balance is taken on by some other part of the reticulo-endothelial system.

Included in the reticulo-endothelial system are the endothelial cells of the bone-marrow, and the megakaryocytes, from which it is thought that platelets arise, are related to and derived from them (Woodcock⁸⁴). The different results obtained by splenectomy in purpura hæmorrhagica may be explained by the conception that it is a disease of the reticulo-endothelial system, and that several types of the malady exist, depending on the part of the reticulo-endothelial system which is damaged—the megakaryocytes of the bone-marrow, the spleen, or the remainder of the system. It is suggested, though it cannot be proved, that the following three types may exist:—

Type I, in which the whole of the reticulo-endothelial system is uniformly affected. The diseased megakaryocytes produce defective platelets which are destroyed excessively by a diseased spleen and the remainder of the reticulo-endothelial system. Hence after splenectomy the result is poor; there is no cessation of hæmorrhages and the platelet-count after a preliminary rise continues to be diminished and the bleeding time prolonged. It is suggested that to this type belong cases Nos. 37, 44, 47, 78, 80, 84, and 97.

Type II, in which the spleen is mostly affected. In consequence an increased number of platelets is destroyed by the diseased spleen; in order

to keep up the numbers, the megakaryocytes are overworked and defective platelets are produced—a secondary myelopathy due to exhaustion. When the spleen is removed the marrow is enabled to recover and an increased number of normal platelets is produced. This type does well after splenectomy. The first case reported in this paper belongs to this group.

Type III, in which the bone-marrow and extrasplenic reticulo-endothelial system are damaged rather than the spleen; the platelets are reduced by the increased destructive activities of the extrasplenic reticulo-endothelial system. In this type splenectomy is useless: there is no rise in platelets after operation and no cessation of hæmorrhages. It is suggested that cases Nos. 13, 27, 30, and 31 are examples of this variety.

The two cases reported in this paper show by contrast the value of splenectomy as a therapeutic measure in this disease, and from an analysis of published results it appears that it is not often successful in the acute type of case; in the vast majority of the chronic, however, it has such beneficial effects as to warrant its performance as soon as the diagnosis of idiopathic purpura hæmorrhagica is made.

CONCLUSIONS.

1. The histological changes in the spleen in purpura hæmorrhagica are those of a general hyperplasia of the endothelial phagocytes.

2. The prolongation of the bleeding time is associated generally with diminution of the platelet-count, the coagulation time being normal.

3. The prolongation of the bleeding time in purpura hæmorrhagica is probably due more to defective quality of the platelets than to diminished numbers.

4. The transfusion of citrated blood in purpura hæmorrhagica is followed in some cases by a temporary fall in bleeding time to normal and a temporary rise in the platelet-count.

5. Purpura hæmorrhagica may be divided into acute and chronic cases; splenectomy is beneficial in 80.9 per cent of the chronic and in 16.6 per cent of the acute.

6. In most cases in which splenectomy is successful, there is a decrease in the bleeding time to normal and an increase in the platelet-count to normal or above normal. When the increase is above normal the count falls subsequently to normal. The normal number may be maintained, or there may be a gradual fall to thrombocytopenia. In some cases there is no rise in the platelet-count nor diminution of the bleeding time.

7. The immediate effect of splenectomy on the blood picture is an increase of erythrocytes and a leucocytosis with a normal proportion of cells. The leucocyte count falls gradually.

8. It is suggested that purpura hæmorrhagica is a disease of the whole of the reticulo-endothelial system, and that three types exist, depending on the extent of involvement of the system. The effect of splenectomy in a given case depends on the type to which the case belongs.

I wish to thank Professor F. R. Fraser, Professor G. E. Gask, Dr. G. Graham, and Mr. R. M. Vick for permission to publish these cases, and Professor Fraser again for his helpful advice and criticism.

ABSTRACT OF 101 CASES OF PURPURA HÆMORRHAGICA TREATED BY SPLENECTOMY.

| AUTHOR AND HISTORY OF CASE | DATES AND OPERATION | BLOOD CORPUSCLES | | Hb. % | PLATELETS | BLEEDING TIME | REMARKS |
|---|--------------------------|--------------------|--------|-------|-----------|------------------|---|
| | | Red | White | | | | |
| Case No. 1. Bass and Cohen² | | | | | | | |
| F., age 8 | 20. 7.23 | Thousands 5,200 | 4,800 | 60 | 11,000 | Minutes 20 | Developed pneumonia after operation, which cleared up well. 5 months no recurrence of hemorrhages. Spleen: weight, 180 gm. Slight hypertrophy of Malpighian bodies. Infiltration of pulp with polymorphs and eosinophils |
| 3 years—hemorrhages from skin and nose | 31. 7.23 | 4,500 | ? | 60 | 2,000 | 16 | |
| 1 hr. after splenectomy | 1. 8.23 | 4,500 | 21,600 | 60 | 42,000 | 5 | |
| 4. 8.23 | 20. 8.23 | 5,600 | 42,600 | 66 | 80,000 | 1 | |
| 20. 8.23 | 20. 10.23 | 4,800 | 16,800 | 56 | 220,000 | 1½ | |
| 10.12.23 | 10.12.23 | ? | 9,600 | 75 | 100,000 | 1½ | |
| | | ? | ? | 80 | 90,000 | 1½ | |
| | | ? | ? | 85 | 60,000 | 1 | |
| Case No. 2. Benecke⁷ | | | | | | | |
| F., age 21 | 3. 7.17 | 2,150 | 3,200 | 30 | 66,000 | ? | 5 years after operation, no recurrences of hemorrhages. Spleen: weight, 230 gm. Hypertrophy of Malpighian bodies. Many platelets in evidence |
| Hemorrhages from nose, uterus, and skin. | 13. 7.17 Splenectomy | 3,250 | 11,000 | ? | 344,000 | ? | |
| Duration 3 years | 16. 7.17 | 3,580 | 7,400 | 42 | 664,000 | ? | |
| | 30. 7.17 | 4,176 | 4,900 | 52 | 577,000 | | |
| Case No. 3. Bowen⁸ | | | | | | | |
| M., age 22 | 28. 8.22 Splenectomy | 1648-5000 | 4,800 | 18 | 2,500 | 20-120 | 14th week after operation: catarrhal jaundice. 29th week: slight epistaxis and purpura. 12th week: jaundice clearing. 1 month: no recurrence of hemorrhages |
| 18 years—purpura. 3 months—hemorrhages from gums, nose, and anus | 2 hrs. after splenectomy | .. | .. | .. | 17,000 | | |
| | 4 hrs. " | .. | .. | .. | 22,000 | 4 | |
| | 20. 8.22 | .. | .. | .. | 190,000 | | |
| | 7. 9.22 | .. | .. | .. | 608,000 | | |
| | 28. 9.22 | .. | .. | .. | 307,000 | | |
| | 4. 9.22 | .. | .. | .. | 100,000 | 14 | |
| | 11. 9.22 | .. | .. | .. | 57,000 | | |
| | 11.10.22 | .. | .. | .. | 20,000 | 70 | |
| | 11.11.22 | .. | .. | .. | 50,000 | 12 | |
| | 1. 1.23 | .. | .. | .. | 95,000 | 8 | |
| Case No. 4. Brill and Rosenthal⁹ | | | | | | | |
| F., age 19 | Oct., 1922 | 2,272 | 6,800 | 38 | 6,400 | 4-4 | Slight bleeding from gums after operation for stone in ureter. Vomiting of clotted blood after operation. No recurrence 8 months after. Spleen: weight, 1400 gm. Vessels intact and not sclerotic. Numerous large follicles, pulp present in normal amount. Stomach not affected or sclerosed. Spleen intact and hypertrophy of Malpighian bodies. No platelets |
| 14 years—hemorrhages into skin and from nose, stomach, and uterus | 2.12.22 Splenectomy | 4,350 | 56,000 | 70 | 95,000 | ? | |
| | 3.12.22 | 4,144 | 40,000 | 66 | 225,000 | 1½ | |
| | 5.12.22 | 3,872 | 16,000 | 60 | 220,000 | 1 | |
| | 11.12.22 | 4,514 | 7,000 | 75 | 60,000 | 4 | |
| | 16.12.22 | 4,960 | 10,000 | 70 | 3,000 | 5 | |
| | 17. 1.23 | 5,632 | 16,000 | 80 | 15,000 | 2 | |
| | 19. 2.23 | 4,194 | 12,400 | 92 | 12,000 | 1½ | |
| | 24. 4.23 | 6,650 | 14,200 | 84 | 240,000 | | |

ABSTRACT OF 101 CASES OF PURPURA HEMORRHAGICA TREATED BY SPLENECTOMY—continued.

| AUTHOR AND HISTORY OF CASE | DATES AND OPERATION | BLOOD CORPUSCLES | | Hb. % | PLATELETS | BLEEDING TIME | REMARKS |
|---|-----------------------------|--------------------|--------|-------|-----------|------------------|---|
| | | Red | White | | | | |
| Case No. 9. Clopton ¹³ | | | | | | | |
| F., age 34 | Transfusion .. | Thousands 2,700 | 3,500 | 40 | 70,000 | Minutes, 4-8 | Worse after transfusion: hemorrhages from gums and nose, 6 months after: no recur- rence of hemorrhages |
| 4 months — hamor- rhages into skin and nose | 2 days after splenectomy .. | 4,500 | 20,000 | 45 | 250,000 | 3½ | |
| | 6 months " .. | 4,060 | 19,600 | 49 | 180,000 | 2 | |
| Case No. 10. Cohn and Lemann ¹⁴ | | | | | | | |
| M., age 5½ | 3. 6.23 .. | 3,780 | 6,500 | 55 | Very few | 5 | Developed pneumonia during convalescence. Recovered well, 6 months; no recurrence of hemorrhages |
| 3 months — hamor- rhages into skin .. | 6. 6.23 Splenectomy .. | 4,730 | 8,700 | .. | 400,000 | ? | |
| | 2. 7.23 .. | .. | .. | .. | 200,000 | ? | |
| | 15.10.23 .. | .. | .. | .. | .. | .. | |
| Case No. 11. Corl ¹⁵ | | | | | | | |
| F., age 13 | 24. 2.21 Splenectomy .. | 2,000 | 8,800 | ? | Very few | 6 | No recurrence of hemorrhages after 10 months |
| 4 years—hemorrhages into skin and nose | 5 hrs. after splenectomy .. | .. | .. | .. | 109,000 | 3 | |
| | 27. 2.21 .. | .. | .. | .. | 386,000 | .. | |
| | 4. 3.21 .. | .. | .. | .. | 740,000 | .. | |
| | 1. 6.21 .. | .. | .. | .. | 271,000 | .. | |
| | 1.11.21 .. | .. | .. | .. | 145,000 | .. | |
| | 1. 2.22 .. | .. | .. | .. | 23,000 | .. | |
| Case No. 12. Corl ¹⁵ | | | | | | | |
| F., age 21 | Before splenectomy .. | 4,200 | ? | 40 | Very few | ? | Malarial parasites found in blood and patient died from subperitoneal abscess 1 month after operation. Splen: weight, 320 grm. Con- tained many platelets |
| 9 years—hemorrhages from nose, gums, and uterus | 17.11.21 Splenectomy .. | .. | .. | .. | 63,000 | ? | |
| | 8 hrs. after splenectomy .. | .. | .. | .. | 307,000 | ? | |
| | 18.11.21 .. | .. | .. | .. | 862,000 | ? | |
| | 21.11.21 .. | .. | .. | .. | 1,150,000 | ? | |
| | 5.12.21 .. | .. | .. | .. | 89,500 | ? | |
| | 6.12.21 .. | .. | .. | .. | .. | .. | |
| Case No. 13. Corpus ¹⁶ | | | | | | | |
| M., age 56 | 4. 5.25 .. | ? | ? | ? | 0 | ? | Death following heart failure. Autopsy: degen- eration of myocardium; hemorrhages into endocardium, peritoneum, and stomach |
| 2 months — hamor- rhages | 9. 5.25 Splenectomy .. | .. | .. | .. | 0 | ? | |
| | 9. 5.25 .. | .. | .. | .. | .. | .. | |
| Case No. 14. Cowen ¹⁷ | | | | | | | |
| F., age 27 | 4. 2.25 .. | 4,040 | 11,000 | 70 | 10,000 | 21 | 3 hours after operation: hemorrhages from lungs stopped, 4 days: vascular hemorrhage stopped. 1 month: no recurrence of hemorrhages. 2 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 3 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 4 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 5 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 6 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 7 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 8 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 9 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 10 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 11 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 12 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 13 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 14 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 15 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 16 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 17 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 18 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 19 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 20 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 21 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 22 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 23 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 24 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 25 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 26 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 27 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 28 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 29 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 30 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 31 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 32 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 33 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 34 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 35 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 36 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 37 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 38 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 39 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 40 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 41 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 42 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 43 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 44 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 45 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 46 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 47 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 48 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 49 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 50 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 51 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 52 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 53 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 54 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 55 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 56 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 57 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 58 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 59 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 60 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 61 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 62 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 63 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 64 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 65 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 66 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 67 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 68 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 69 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 70 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 71 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 72 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 73 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 74 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 75 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 76 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 77 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 78 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 79 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 80 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 81 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 82 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 83 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 84 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 85 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 86 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 87 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 88 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 89 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 90 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 91 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 92 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 93 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 94 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 95 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 96 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 97 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 98 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 99 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. 100 months: 1st hemorrhage into skin, 2nd into nose, 3rd into vagina, 4th into skin. |
| 8 months — malaise, 10 days — hemorrhages from nose, vagina, penis, skin | 10. 2.25 Splenectomy .. | .. | .. | .. | Very few | 4 | |
| | 15. 2.25 .. | .. | .. | .. | 400,000 | 5 | |
| | 24. 2.25 .. | .. | .. | .. | 1,000,000 | 5 | |
| | 7. 3.25 .. | .. | .. | .. | .. | .. | |

| | | | | | | | |
|--|---------------------------------------|-------|----|----|---------|--------|--|
| F., age 10 .. 4 years—hemorrhages from nose, skin, and uterus | 13. 3.25 | .. | .. | .. | 200,000 | 3 | than normal. Interior of capillaries and smaller arteries hypertrophied. No increase of fibrous tissue |
| | 21. 3.25 | .. | .. | .. | 400,000 | 3 | |
| | 17. 4.25 | 5,400 | .. | .. | 550,000 | ? | |
| Case No. 16, Eklund ²¹ | | | | | | | |
| F., age 22 9 years—hemorrhages from skin, gums, and uterus | Before splenectomy .. | ? | ? | ? | 0 | 20-120 | 3½ years after operation: no recurrence of hemorrhages |
| | 2½ hours after splene- ctomy | .. | .. | .. | 87,500 | | |
| | 1 day after splenectomy .. | .. | .. | .. | 118,000 | 3-6 | |
| | 5 days | .. | .. | .. | 684,000 | | |
| | 2 months | .. | .. | .. | 60,000 | | |
| F., age 22 9 years—hemorrhages from skin, gums, and uterus | 4½ years | .. | .. | .. | 10,000 | | |
| | 3rd day after splene- ctomy | 2,120 | ? | ? | 10,000 | ? | 1st day after operation: menorrhagia and carrelage. 2nd day: transfusion. 2½ months: no recurrence after 2nd day |
| | 10 weeks after splene- ctomy | .. | .. | .. | 230,000 | ? | |
| Case No. 17, Engel ²² | | | | | | | |
| M., age 20 3 days—hemorrhages from skin, gums, kid- ney, stomach, and bowel | Before splenectomy .. | 4,500 | ? | ? | 0 | 180 | Patient died 4 hours after operation. Autopsy: hemorrhages into skin and serous cavities; necrosis of bone |
| | 10 weeks after splene- ctomy | .. | .. | .. | 148,000 | | |
| Case No. 18, Engel ²² | | | | | | | |
| M., age 44 3 days—hemorrhages from skin, kidney, and bowel | Before splenectomy .. | 2,210 | ? | ? | 00,000 | ? | Died 6 hours after operation. Autopsy: hemor- rhages into gastro-intestinal tract, ganlio- nary tract, and heart. Tuberculosis of lymph gland |
| | 1 day after splene- ctomy | .. | .. | .. | | | |
| | 2 days | .. | .. | .. | | | |
| Case No. 19, Engel ²² | | | | | | | |
| F., age 17 10 days—hemorrhages from skin, gums, and uterus | 1 day after splene- ctomy | 1,240 | ? | ? | 14,800 | 12 | Severe nose-bleed on 12th day. No recurrence after 3 months |
| | 2 days | .. | .. | .. | 29,000 | | |
| | 12 days | .. | .. | .. | 115,000 | | |
| | 3 months | 4,000 | .. | .. | 101,000 | | |
| Case No. 20, Eylonberg ²³ | | | | | | | |
| F., ? age Hemorrhages into skin, and from uterus | Before splenectomy .. | 1,252 | ? | ? | 38,420 | ? | 3 months after operation: no recurrence |
| | 3 days after splenectomy .. | .. | .. | .. | 34,400 | | |
| | 2 months | .. | .. | .. | 577,000 | | |

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ABSTRACT OF 101 CASES OF PURPURA HÆMORRHAGICA TREATED BY SPLENECTOMY—continued.

| AUTHOR AND HISTORY OF CASE | DATES AND OPERATION | BLOOD CORPUSCLES | | IDB. % | PLATELETS | BLEEDING TIME | REMARKS |
|--|--------------------------|--------------------|--------|---------|-----------|---|--|
| | | Red | White | | | | |
| Case No. 21. Farley ²¹ | | | | | | | |
| F., age 18 2 months—hemor- rhages into skin and from gums and vagina | 4.11.24 | Thousands 3,000 | 9,600 | 35 | ? | Minutes ? | Differential_W.B.C.:— 4.11.24 18.11.24 23.11.24 per cent per cent per cent |
| | 11.11.24 | 945 | 9,400 | 25 | 40,000 | 20 | 31 60 42 |
| | 12.11.24 Transfusion | | | | | | Polymorphs .. 32 7 3 |
| | 15.11.24 Transfusion | | | | | | Lymphocytes .. 2 1 — |
| | Splenectomy | | | | | | Large mononuclears .. 4 2 — |
| | 16.11.24 | 1,270 | | 25 | 80,000 | | Eosinophils .. 31 — 66 |
| | 18.11.24 | 1,043 | 37,000 | 25 | 70,000 | | Myelocytes .. 40 55 |
| | 19.11.24 Transfusion.. | 786 | 54,000 | 20 | 64,000 | | Splen: blood spaces filled with myeloblasts and |
| | 22.11.24 Transfusion.. | | 23,000 | | 39,000 | | myelocytes. No uniform hyperplasia of cells |
| 23.11.24 | | 55,000 | | 105,000 | | in situ with destruction of architecture so | |
| 28.11.24 | | 1,100 | 53,000 | 20 | 7,200 | | characteristic of the myeloid hyperplasia of |
| | | | | | | | myeloid leukaemia. ? Erythrum haemorrhagica. |
| | | | | | | | ? Acute myeloid leukaemia |
| | | | | | | | 29.11.24: died |
| Case No. 22. Giffin ²² | | | | | | | |
| F., age 31 1½ years—hemorrhages into skin and from nose, gums, and uterus | Dec., 1922 | 3,260 | ? | 55 | 24,000 | ++ | 3-1 days after operation: slight oozing from |
| | Jan., 1923 | 1,610 | 7,000 | 18 | ? | ? | uterus. 20 months after: no recurrence. |
| | Just before splenectomy | | | | 40,000 | | Splen: weight, 210 gm. Increase in number |
| | 7. 3.23 Splenectomy | | | | | | of neutrophils in splenic pulp. Germ centres |
| | 6 hrs. after splenectomy | | | | | | apparently active. Some brown pigment. |
| | 9. 3.23 | | | | 202,000 | | Otherwise normal |
| | 23. 3.23 | | | | 727,000 | | |
| 21. 4.23 | | 4,000 | | 68 | 365,000 | | |
| Case No. 23. Giffin ²³ | | | | | | | |
| F., age 23 13 years—hemorrhages from skin, nose, and uterus | June, 1923 | 3,370 | 7,200 | 54 | 116,000 | 22 | No recurrence until 1 year later when vaccinated, |
| | Aug., 1923 | | | | 28-70,000 | | arm sore but no secondary infection: crop of |
| | Sept., 1923 | | | | 136,000 | 18 | petechiae. 17 months after operation: no |
| | 27.10.23 | 4,430 | 8,800 | 55 | 62,000 | 6½ | recurrence. Splen: weight, 200 gm. Nothing |
| | 29.10.23 Splenectomy | | | | | | abnormal except increase in number of neutro- |
| | 5 hrs. after splenectomy | | | | 80,000 | 2½ | phils, and several eosinophilic myelocytes. |
| | 30.10.23 | | | | 146,000 | | Small amount of brownish pigment in pulp. |
| | 4.11.23 | | | | 638,000 | 4 | Germ centres apparently active |
| | 13.11.23 | | 4,900 | 12,700 | 58 | 214,000 | 1½ |
| 5½ mths. after operation | | | 10,000 | | 150,000 | | |
| Case No. 24. Giffin ²⁴ | | | | | | | |
| M., age 24 12 years—hemorrhages, from nose, gums, and skin | Jan., 1920 | 3,770 | 5,000 | 23 | 88,000 | 40 | Wassermann reaction positive, but no clinical |
| | July, 1921 | 1,860 | 5,100 | 66 | 284,000 | 33 | evidence of syphilis. In months after opera- |
| | Feb., 1924 | | | | 182,000 | 20 | tion: no recurrence. Splen: weight, 229 gm. |
| | 22. 2.24 Splenectomy | | | | | | Normal except for increase in number of neutro- |
| 2 wks. after splenectomy | | | | | 260,000 | 2 | phils. Many eosinophils |

| | | | | | | | | |
|--|--|---|-------|-------|----|----------|----|--|
| Case No. 25. Giffin ²⁸ | | Mar., 1924 .. | 3,480 | 9,800 | 50 | 40,000 | 38 | 2nd day after operation: epistaxis, 3 weeks after: coryza, petechiae, and epistaxis, 1 year after: no recurrence of hemorrhage. Spleen: weight, 168 gm. Normal except that blood-vessels in the Malpighian bodies were hyalinized. Some pigment, but no more than normal. Perhaps an increase in number of neutrophils |
| F., age 11 .. | | 10. 3.24 Splenectomy | .. | .. | .. | 100,000 | 8 | |
| 5½ years—hemorrhages from nose and skin | | 20. 3.24 .. | .. | .. | .. | 98,000 | 5 | |
| | | 22. 3.24 .. | .. | .. | .. | 430,000 | 2½ | |
| | | 24. 3.24 .. | .. | .. | .. | 208,000 | | |
| | | 25. 3.24 .. | .. | .. | .. | 50,000 | | |
| | | 3 wks. after splenectomy | .. | .. | .. | | | |
| Case No. 26. Hahnan ²⁰ | | Before splenectomy .. | 3,000 | ? | 40 | Very few | 17 | 6 months after operation: no recurrence of hemorrhages |
| F., age 17 .. | | 3 mths. after .. | 4,500 | .. | .. | 170,000 | | |
| Case No. 27. Hartung ³¹ | | 13. 8.24 .. | 3,150 | 7,300 | 70 | 100,000 | 15 | 3 days after operation: collapse. 7 days after: died |
| M., age 45 .. | | 4. 0.24 .. | 1,630 | 8,300 | 30 | | | |
| 1 month—hemorrhages into skin and from nose and gums | | 5. 0.24 Transfusion | 3,300 | .. | 30 | 70,000 | | |
| | | 9. 0.24 .. | 960 | .. | 20 | | | |
| | | 23. 9.24 .. | | .. | | | | |
| | | 23. 0.24 Transfusion | | .. | | | | |
| | | 24. 0.24 Splenectomy | 1,000 | .. | .. | 100,000 | | |
| | | 1.10.24 .. | | | | | | |
| Case No. 28. Hauke ³² | | Before splenectomy .. | 1,300 | ? | 15 | 800 | 36 | 6 months after operation: only occasional petechiae |
| F., age 5 .. | | 2½ mths. after .. | 6,700 | .. | 62 | 10,000 | ? | |
| 3 years—hemorrhages from nose and stomach | | 0 mths. after .. | 4,100 | .. | 81 | 3,600 | | |
| Case No. 29. Henrhan ³³ | | Before splenectomy .. | 4,200 | .. | ? | Few | 6 | Died 2 hours after splenectomy. No autopsy |
| F., age 46 .. | | 6 months—hemorrhages from skin, uterus, and bowel | | | | | | |
| Case No. 30. Henrhan ³³ | | Before splenectomy .. | 1,600 | ? | 32 | 120,000 | 17 | 30 days after operation: died. Autopsy: furneriosis, abscesses in lungs, myocardium, and kidneys |
| F., age 21 .. | | 1 day after splenectomy | .. | .. | .. | 120,000 | ? | |
| 18 months—hemorrhages from gums, uterus, and skin | | 18 days after .. | .. | .. | .. | 160,000 | ? | |
| Case No. 31. Herfarth ³¹ | | Before splenectomy .. | 3,100 | ? | 35 | 30,000 | 23 | No recurrence of hemorrhages |
| M., age 10 .. | | 1 day after .. | .. | .. | .. | 30,000 | | |
| 7 years—hemorrhages into skin and from nose | | Later .. | .. | .. | .. | 350,000 | | |

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ABSTRACT OF 101 CASES OF PURPURA HEMORRHAGICA TREATED BY SPLENECTOMY—continued.

| AUTHOR AND HISTORY OF CASE | DATES AND OPERATION | BLOOD CORPUSCLES | | Hb. % | PLATELETS | BLEEDING TIME | REMARKS |
|---|---|--------------------|--------|-------|-----------|------------------|--|
| | | Red | White | | | | |
| Case No. 32. Herfarth ³¹ F., age 23 3 years—hemorrhages from nose and uterus | Before splenectomy .. 10 days after " .. 3 months after " .. | Thousands 3,700 | ? | 61 | 30,000 | Minutes ? | 3 months after operation: no recurrence |
| | | .. | .. | .. | 180,000 | ? | |
| | | 4,400 | .. | 58 | 344,000 | 2 | |
| Case No. 33. Herrman ³⁶ F., age 16 4 days—hemorrhages from nose, skin, and uterus | Before splenectomy .. | 2,500 | ? | 60 | ? | ? | Died a few hours after splenectomy. Autopsy: subcutaneous, subserous, and paraclymionous hemorrhages |
| | | | | | | | |
| Case No. 34. Hiltzro ³⁷ F., age 8 3 years—hemorrhages from nose, skin, gums, stomach; melena | 27. 1.23 27. 2.23 Splenectomy "After operation" .. 26. 4.23 | 2,400 | 38,000 | 40 | 40,500 | 20 | 27.1.23; leucocytosis owing to bronchopneu- monia. No recurrence 2 months after. <i>Splen:</i> weight, 120 gm. Hyperplasia of pulp. Mye- loidization. Many follicles of normal size. Many polymorphs. Arteries in follicles show thickening and hyaline degeneration of wall. Moderate number of myelocytes. Slight increase of eosinophils. No platelets |
| | | .. | .. | .. | 600,000 | 5 | |
| | | .. | .. | 40 | ++ | 21 | |
| Case No. 35. Kaznelson ³⁸ F., age 36 Since childhood—pete- chie and purpura 10 years—purpura and menstruation 10 days | 1.10.16 10.10.16 Splenectomy 12.10.16 18.10.16 1.11.16 16.11.16 28.11.16 18.12.16 23. 3.17 31. 7.17 30. 9.24 | 3,100 | 2,700 | ? | 300 | ? | No recurrence of hemorrhages 10 years after |
| | | .. | .. | .. | 600,000 | Normal | |
| | | .. | .. | .. | 460,000 | | |
| | | .. | .. | .. | 231,000 | | |
| | | .. | .. | .. | 183,000 | | |
| | | .. | .. | .. | 90,000 | | |
| | | .. | .. | .. | 125,000 | | |
| | | .. | .. | .. | 124,000 | | |
| | | .. | .. | .. | 164,000 | | |
| | | .. | .. | .. | 332,000 | | |
| Case No. 36. Kaznelson ³⁹ F., age 25 5 years—hemorrhages into skin and from nose and uterus | 14.11.16 18.11.16 Splenectomy 2 hours after " .. 19.11.16 21.11.16 27.11.16 9.12.16 21.12.16 19. 2.17 30. 7.17 30. 4.23 | 5,000 | ? | ? | 500 | ? | 6 months after: occasional slight epistaxis. No recurrence after 5 years |
| | | .. | .. | .. | 8,800 | | |
| | | .. | .. | .. | 93,000 | | |
| | | .. | .. | .. | 240,000 | | |
| | | .. | .. | .. | 17,800 | | |
| | | .. | .. | .. | 3,000 | | |
| | | .. | .. | .. | 8,500 | | |
| | | .. | .. | .. | 31,400 | | |
| | | .. | .. | .. | 10,100 | | |
| | | .. | .. | .. | Normal | | |

| | | | | | | | | |
|--|-------------------------------|-------|-------|----|-----|-----------|----|--|
| Case No. 37. Kaznelson ¹⁰ | | | 5,500 | ? | 120 | 0,700 | ? | 25.12.16: severe epistaxis and hematocells, 1925: a few petechiae and occasional epistaxis |
| F., age 11 .. | Before splenectomy.. | .. | .. | .. | .. | 13,100 | .. | |
| 3 years—petechiae, epistaxis | 18.12.16 Splenectomy | .. | .. | .. | .. | 216,000 | .. | |
| | 3½ hours after " | .. | .. | .. | .. | 58,000 | .. | |
| | 19.12.16 .. | .. | .. | .. | .. | 13,000 | .. | |
| | 23.12.16 .. | .. | .. | .. | .. | 1,700 | .. | |
| | 25.12.16 .. | .. | .. | .. | .. | 5,500 | .. | |
| | 12. 1.17 .. | .. | .. | .. | .. | 6,800 | .. | |
| | 17. 5.17 .. | .. | .. | .. | .. | 1,000 | .. | |
| | 13. 9.17 .. | .. | .. | .. | .. | | .. | |
| | 1925 .. | .. | .. | .. | .. | | .. | |
| Case No. 38. Kaznelson ¹¹ | | | .. | .. | .. | 600 | | 11.11.20: died at operation. Autopsy: marked degeneration and bleeding into myocardium |
| F., age 20 .. | 11.11.20 .. | .. | .. | .. | .. | | | |
| 1 month — hemorrhage from nose, uterus, and under skin | 11.11.20 Splenectomy | .. | .. | .. | .. | | | |
| Case No. 39. Kaznelson ¹¹ | | | .. | .. | .. | 42,000 | | No recurrence after 4 years |
| F., age 30 .. | 20. 6.21 .. | .. | .. | .. | .. | 385,000 | | |
| Several years—hemorrhage from nose, uterus, and under skin | 20. 6.21 Splenectomy | .. | .. | .. | .. | 530,000 | | |
| | 21. 6.21 .. | .. | .. | .. | .. | 963,000 | | |
| | 23. 6.21 .. | .. | .. | .. | .. | 1,370,000 | | |
| | 26. 7.21 .. | .. | .. | .. | .. | 280,000 | | |
| | 1. 8.21 .. | .. | .. | .. | .. | 200,000 | | |
| | 10. 2.22 .. | .. | .. | .. | .. | | | |
| | 1. 7.25 .. | .. | .. | .. | .. | | | |
| Case No. 40. Reismann ¹² | | | 2,400 | ? | 40 | 4,500 | ? | 6 months after: occasional epistaxis, 1 year after: severe menorrhagia. Result poor |
| F., age 17 .. | Before splenectomy .. | .. | .. | .. | .. | 220,000 | ? | |
| 4 years—hemorrhages from gums and stomach | 6 hours after splenectomy .. | .. | .. | .. | .. | 240,000 | ? | |
| | 6 months after splenectomy .. | 4,000 | .. | .. | 75 | | | |
| Case No. 41. Von Krehl ¹³ | | | .. | .. | .. | 10,000 | 37 | 6.10.25: No recurrence |
| F., age 26 .. | Jan., 1925 .. | .. | .. | .. | .. | 900 | 50 | |
| Hemorrhage from nose and uterus | Feb., 1925 .. | .. | .. | .. | .. | 20,000 | 1 | |
| | 17. 2.25 Splenectomy | .. | .. | .. | .. | 60,000 | | |
| | 18. 2.25 .. | .. | .. | .. | .. | 100,000 | | |
| | 25. 2.25 .. | .. | .. | .. | .. | 138,000 | | |
| | 28. 2.25 .. | .. | .. | .. | .. | | | |
| | 6.10.25 .. | .. | .. | .. | .. | | | |

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ABSTRACT OF 101 CASES OF PURPURA HÆMORRAGICA TREATED BY SPLENECTOMY—continued.

| AUTHOR AND HISTORY OF CASE | DATES AND OPERATION | BLOOD CORPUSCLES | | Hb. % | PLATELETS | BLEEDING TIME | REMARKS |
|---|---|---|--|--|--|--|--|
| | | Red | White | | | | |
| Case No. 81. <i>Start</i> ⁷⁰ No details | Before splenectomy .. 1 day afr. splenectomy 3 days afr. splenectomy | Thousands .. .. .. | .. .. .. | .. .. .. | 0 Very few Very few | Minutes | Died of pachymeningitis hemorrhagica. Massive clots over both hemispheres beneath dura |
| Case No. 82. <i>Steinbrink</i> ⁷¹ F., age 5 2½ years — hemorrhages into skin, and from nose and stomach | Before splenectomy .. 3. 9.27 Splenectomy .. ? after splenectomy .. 9 wks. after .. Later .. | 1,770 | 12,000 .. 26,400 .. | 15 | 1,300 8-18,000 ++ .. | 12 5½ | 5 months after operation: slight epistaxis and petechia. General condition good |
| Case No. 83. <i>Sternberg</i> ⁷² F., age 64 Chronic hemorrhage from uterus and into skin | Before splenectomy .. 24 hrs. after .. 2 days after .. 3 days after .. 6 days after .. 11 days after .. 20 days after .. 2 mths. after .. | 4,620 | ? | 87 | 62,600 187,000 78,000 68,000 91,800 129,000 130,000 109,000 | 12 1½ 4 4 4 5 6 5 | No recurrence after 2 months |
| Case No. 84. <i>Sternberg</i> ⁷² F., age 64 1 year—purpura | Before splenectomy .. 24 hrs. after .. | 4,120 .. | ? .. | 85 .. | 36,000 187,000 | 20 1½ | Bleeding recurred in 2 months. Result poor |
| Case No. 85. <i>Sutherland and Williamson</i> ⁷³ F., age 8 3 years — hemorrhages into skin and conjunctiva and from nose and stomach | Mar., 1923 .. Apr., 1924 .. 9. 6.24 .. 18. 6.24 .. 19. 6.24 Splenectomy 23. 6.24 .. 30. 6.24 .. 8. 7.24 .. 15. 7.24 .. 30. 7.24 .. 8. 9.24 .. 5.11.24 .. | 5,000 4,500 5,300 5,000 4,800 | 45,000 .. 35,000 12,000 30,000 18,000 12,000 20,000 18,000 15,000 15,000 | 98 65 50 50 40 45 48 60 60 60 75 | 18,000 15,000 30,000 40,000 120,000 160,000 140,000 30,000 125,000 | 31 | Petechia and ecchymosis still occasionally occur after 8 months. No external bleeding. <i>Spleen</i> : Malpighian corpuscles prominent. Great diminution in number of lymphocytes, and marked endothelial proliferation in Malpighian bodies and sinuses. Connective tissue of sinuses swollen and hyaline. No blood-platelets |

| | | | | | | | | | |
|--|--|-------------------------|----------------------|-------|--------|----|--------------------|---------|---|
| Case No. 86. Sutherland and Williamson ⁷³ | | M., age 9 | Jun., 1924 | 1,500 | 20,000 | 20 | .. | 15 | 5 months after: no recurrence of hemorrhages. Spleen: as in No. 85 |
| | | 6 months — hemor- | 1. 5.24 | 2,600 | 10,000 | 20 | 5,000 | | |
| | | rhages into skin and | 2. 6.24 | 3,200 | .. | 28 | 5,000 | | |
| | | from nose, bowel, and | 29. 6.24 | 5,200 | 15,000 | 45 | | | |
| | | stomach | 3. 7.24 Splenectomy | 4,000 | .. | 40 | 150,000 | | |
| | | | 9. 7.24 | 4,500 | .. | 40 | 180,000 | | |
| | | | 16. 7.24 | 5,500 | .. | 70 | 350,000 | | |
| | | | 14. 8.24 | 4,500 | .. | 70 | 200,000 | Normal | |
| | | | 14. 10.24 | | | | | | Once slight epistaxis, since then no recurrence |
| Case No. 87. Tietze ⁷⁶ | | F., age 5 | Before operation | .. | .. | .. | 8,300 | 20 | |
| | | Purpura and epistaxis | 1 hr. after " | .. | .. | .. | 11,000 | | |
| | | | 18 hrs. after " | .. | .. | .. | 11,000 | 6-8 | |
| | | | 1 week after " | .. | .. | .. | 30,000 | | |
| Case No. 88. Vincent ⁷⁸ | | F., age 64 | Before splenectomy | .. | .. | .. | Very few | 7 | 10 months after: no recurrence |
| | | Chronic purpura | 9 days after " | .. | .. | .. | Normal | | |
| Case No. 89. Vincent ⁷⁷ | | F., age 28 | Apr., 1922 | 2,712 | 7,600 | 25 | 1,000 | ? | |
| | | 17 years — hemor- | Apr., 1924 | 4,000 | 5,800 | 75 | Very few | 40 | |
| | | rhages into skin and | 23. 4.24 Splenectomy | .. | 12,000 | .. | No change | | Polynormia |
| | | from gums, nose, rel- | 6 hrs. after " | .. | 10,000 | .. | Slightly below | | Lymphocytes |
| | | in, and uterus .. | 24 hrs. after " | .. | .. | .. | normal | | Large mononuclears |
| | | | | .. | .. | .. | Normal | | Eosinophils |
| | | | 30. 4.24 | 4,320 | 7,800 | .. | Normal | | 1 year after operation: no recurrence. Spleen: infiltration of reticulum with small round cells resembling lymphocytes, and collections of large lymphocytes in follicles |
| | | | 8. 5.24 | 3,000 | 6,200 | 80 | Slightly below | | April, 1922 |
| | | | 16. 6.24 | .. | .. | .. | Normal | | April, 1923 |
| | | | | .. | .. | .. | Normal | | per cent |
| | | | 13. 4.25 | 4,480 | 7,800 | 85 | Normal | Normal | per cent |
| Case No. 90. Vincent ⁷⁷ | | F., age 13 | ? | 2,284 | 9,000 | 33 | 0 | 1 hr. + | Before splenectomy |
| | | 2 years — hemor- | 22. 2.24 | 2,380 | 10,000 | 40 | Very few | 12 | per cent |
| | | rhages from nose, skin, | 23. 2.24 Splenectomy | .. | .. | .. | Increased | .. | Polynormia |
| | | and gums | 24. 2.24 | .. | .. | .. | Above normal | 21 | Lymphocytes |
| | | | 25. 2.24 | .. | .. | .. | Normal | | Large mononuclears |
| | | | 2. 3.24 | .. | .. | .. | Slightly retracted | | Myelocytes |
| | | | 11. 3.24 | 3,806 | 13,400 | .. | Normal | | Eosinophils |
| | | | 18. 3.24 | 5,104 | .. | 65 | Slightly retracted | | 9 months after operation: slight epistaxis twice, 14 months after: no recurrence. Spleen: weight, 157 gm. Hyperplasia of cells of lymphocyte series. No myeloid elements. No nucleated reds. Occasional megakaryocytes. Eosinophils fairly common |
| | | | 1. 11.24 | .. | .. | .. | 4-5 times normal | 3 | Before |
| | | | 1. 4.25 | 4,800 | 20,000 | 80 | Normal | Normal | 1.4.25 |

Continued on next page

ABSTRACT OF 101 CASES OF PURPURA HÆMORRHAGICA TREATED BY SPLENECTOMY—continued.

| AUTHOR AND HISTORY OF CASE | DATES AND OPERATION | BLOOD CORPUSCLES | | Hb. % | PLATELETS | BLEEDING TIME | REMARKS |
|---|--|--------------------|-------|-------|------------------|------------------|--|
| | | Red | White | | | | |
| Case No. 91. Vincent ⁷⁷ F., age 14 5 years — hæmorrhages from nose, skin, gums, and uterus | Before splenectomy .. | Thousands 3,464 | 9,600 | 35 | Very few | Minutes 45 | 11 months after: no recurrence. <i>Spleen</i> : weight, 135 gm. Fibrosis of pulp. Follicles numerous. Occasional megakaryocytes in sinuses. Hyperplasia. |
| | 26. 5.24 Splenectomy 3 days after " | .. | .. | .. | Normal | Normal | |
| | 11 days after " | .. | .. | .. | 1/2 normal | 4 1/2 | |
| | 5 mths. after " | .. | .. | .. | Sl. dim. | Normal | |
| | 11 mths. after " | 4,880 | 7,000 | 80 | 2-3 times normal | | |
| Case No. 92. Vincent ⁷⁷ F., age 6 2 months—epistaxis | Before splenectomy .. | 3,240 | 7,200 | 60 | 0 | 18 | 4 months after: no recurrence. <i>Spleen</i> : increase of connective tissue of reticulum with hyperplasia of lymphoid cells of sinuses of pulp. No evidence of hamatopoiesis. Lymph nodes do not show prominent germinal centres. Hyperplasia |
| | 18.12.24 Splenectomy 2 days after " | .. | .. | .. | Dim. | 3 | |
| | 8 days after " | 4,960 | 8,500 | 90 | Normal | Normal | |
| | 4 mths. after " | 5,440 | 7,200 | 85 | Mod. increased | | |
| Case No. 93. Vogel ⁷⁹ M., age 12 7 years — hæmorrhages from nose, skin, and rectum | Before splenectomy .. | ? | ? | .. | 25,000 | 90 | 10 months after operation: no recurrence of hæmorrhages |
| | Shortly after " | .. | .. | .. | No increase | | |
| | 10 mths. after " | .. | .. | .. | 20,000 | Normal | |
| | | | | | | | |
| Case No. 94. Vogel ⁷⁹ F., age 17 1 year — hæmorrhages from nose and uterus | Before splenectomy .. | .. | .. | .. | 0 | 25 | 14 months after operation: no recurrence of hæmorrhages |
| | 14 days after " | .. | .. | .. | 900,000 | | |
| | 14 mths. after " | .. | .. | .. | 32,000 | | |
| | | | | | | | |
| Case No. 95. Waugh ⁸⁰ No details | After splenectomy .. | .. | .. | .. | 155,000 | | 2 months after: no recurrence |
| | | | | | | | |
| Case No. 96. Whipple ⁸¹ M., age 18 4 years — hæmorrhages into nose, skin, | Before splenectomy .. | 4,200 | .. | 65 | 0 | 12 | 4 months after: no recurrence. General health very good |
| | 1 day after " | .. | .. | .. | 50,000 | | |
| | 2 days after " | .. | .. | .. | 80,000 | 3 | |
| | | .. | .. | .. | 180,000 | | |

| | | | | | | | |
|--|--|--|--|--|--|-------------------|---|
| Case No. 97. Whipple ⁸¹ F., age 47 Many years — hemorrhage into skin, nose, and gums | Before splenectomy .. 1 day after .. 2 days after .. 6 days after .. 8 days after .. 2½ mths. after .. | 4,400 | 7 | 75 | >5,000 25,000 30,000 100,000 30,000 10,000 | 8 1½ 18 | After operation, occasional petechiae, one epistaxis, some bleeding from gums. Much stronger. Follow-up for 3½ months |
| Case No. 98. Whipple ⁸¹ F., age 25 Many years — hemorrhage into skin and uterus | Before splenectomy .. 3 days after .. 5 days after .. 6 days after .. | 3,400 .. .. .. | .. .. .. .. | 59 | 15,000 35,000 65,000 40,000 | 4 | Still in hospital at time of report with post-operative massive collapse of lung. No recurrence of hemorrhages |
| Case No. 99. Whipple ⁸¹ F., age 42 4 weeks — hemorrhage into skin, nose, and gums | Before splenectomy .. | 3,000 | .. | 50 | 4,000 | 8 | Patient died in another hospital one hour after operation |
| Case No. 100. Wittkower ⁸² M., age 15 Since childhood — pure. Admitted immediately with rupture of spleen | Before splenectomy .. 7. 6.22 Splenectomy Immediately after splenectomy .. 8. 0.22 .. 12. 0.22 .. 20. 6.22 .. 14. 7.22 .. | 2,000 .. .. .. .. .. .. | .. .. .. .. .. .. .. | 36 | 02,500 81,000 324,000 1,033,000 8,200,000 | 5 6½ 2 | 9 months after operation: no recurrence of hemorrhages |
| Case No. 101. Wittkower ⁸³ M., age 15 Epistaxis and hemophysis | Dec., 1922 .. May, 1925 .. 4. 0.25 .. 16. 9.25 Splenectomy 1 hr. after splenectomy 17. 0.25 .. 18. 0.25 .. 22. 0.25 .. 10 10 25 .. | | | | 50,000 30,000 34,500 68,400 132,000 168,000 805,000 170,000 | 12 10½ | No recurrence of hemorrhages 6 months after operation |

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*SPECIAL ARTICLES
ON SURGICAL TECHNIQUE.*

SURGICAL DIATHERMY IN BREAST CANCER:*

**THE APPLICATION OF THE ARC ELECTRODE OR CUTTING CURRENT
TO THE RADICAL OPERATION.**

By JOHN ANDERSON,

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WHEN we review the follow-up and end-results of the radical operation for cancer of the breast we realize that there is great room for improvement. Leitch¹ estimates that only 10 per cent of operated cases will be alive after ten years, and we all have had our disappointments in viewing recurrence in cases we had looked on as early, accessible, and removable cancer.

Until some specific method of dealing with the cancer cell has evolved, it seems that we must concentrate on propaganda and improvement of operative procedure. It does not appear possible to extend the anatomical limits of the present-day operation; but anything which will improve its technique appears sound.

The arc electrode has been used to replace the scalpel in all my operations for mammary cancer during the last four years, and the results over that period seem materially better than those obtained when using the scalpel.

I have avoided putting my findings into print at an earlier date because I fully realize that even four years is far too short a period to form a convincing opinion on the subject of mammary cancer when the end-results are incomplete and must remain so for years to come, but I have convinced myself, and I venture to think certain colleagues whose opinion I respect, that the procedure is (1) safe, and (2) a distinct advance on the scalpel dissection of neoplastic disease, and worthy of investigation and control by other workers. Much work has been done recently on the same lines by G. A. Wyeth and Howard A. Kelly, and their opinions seem voiced in the following quotations from their reports:—

Wyeth² says: "Operating on a case of tumour of the bladder, the usual incision was made by the scalpel. The growth was thoroughly exposed by electric light in the bladder and treated after the technique of monopolar endothermy. The bladder was sutured in the usual way, without drain.

* The method and results here reported have been secured by team work, in which I have been responsible for the surgical part, Dr. G. H. S. Milln for the electrical, and Dr. J. M. Clark for the anæsthetic.

"After three months, cystoscopic examination showed that the site of the lesion was free and clean. So smooth had been the healing that it was difficult to be sure just where the growth had been, but on turning the beak of the cystoscope upward the observer was amazed to see along the line of the scalpel's incision three carcinomatous nodules. There could hardly be a more graphic picture of the beneficent healing action of the high-frequency current as contrasted with the lack of protection against implantation provided by the scalpel."

Writing on endothermy as 'the new surgery'. Howard A. Kelly³ says: "In the old-fashioned, bloody surgical operations commonly in vogue, I now begin to think with repulsion of the messiness of the procedure, the sponging, the tying, the needling, and the general manipulations of the wound which must contribute to so many bad results. I therefore welcome this new method of coagulation as a great addition to our technique, not only enabling us to do some things better, but greatly enlarging our field of beneficent activity. I give the Wyeth sector the leading place and decided preference in my daily work, relegating the scalpel to a subordinate position."

It has been long recognized that the cancer cell is more vulnerable to heat than the normal cell. Therefore electrothermic methods offer greater security against recurrence, as they produce a maximum destruction of neoplastic tissue.

A. C. Scott⁴ uses an electric cautery for radical excision of the breast, and his results, as reported to the American Medical Association in 1925, are absolutely outstanding. The electrode appears to have all the advantages of the actual cautery without its disadvantages.

In September, 1923, while on a visit to Stockholm, I saw at the Radium Institute (Professor Gösta Forssell) a case of cancer of the breast excised by the 'diathermy knife'. This type of section of tissue was new to me, though I had previously practised excision of the tongue with a heavier electrode (electro-coagulation). The operation I saw on that occasion was not so extensive as I practise with the scalpel. The skin was widely excised and the chest wall was cooked by button coagulation, no attempt being made to dissect back flaps and suture the skin. I determined to investigate the possibilities of applying the method to the operation which we practise.

On my return to work, I consulted with Dr. G. H. S. Milln, our senior medical electrician, and we immediately set about a series of experiments with the machines available. We very soon found that the small machine made by Schall for medical diathermy produced an excellent 'cutting' current with the knife electrode, which I purchased from Stille, of Stockholm.

APPARATUS EMPLOYED.

The apparatus that we use (*Fig. 362*) is made by Messrs. Schall & Son, No. 6180, and is built for 200 volts D.C.* Its weight is 62 lb., and it costs

* Dr. Milln communicates that a new portable diathermy apparatus has been designed by Mr. Schall which works off alternating current of voltage from 100 to 150 and produces a low-voltage current, and that it appears to cut with equal efficiency.

£38. We have tried many other diathermy machines, but find that they either do not cut at all or only 'cleave' feebly and produce excessive coagulation.

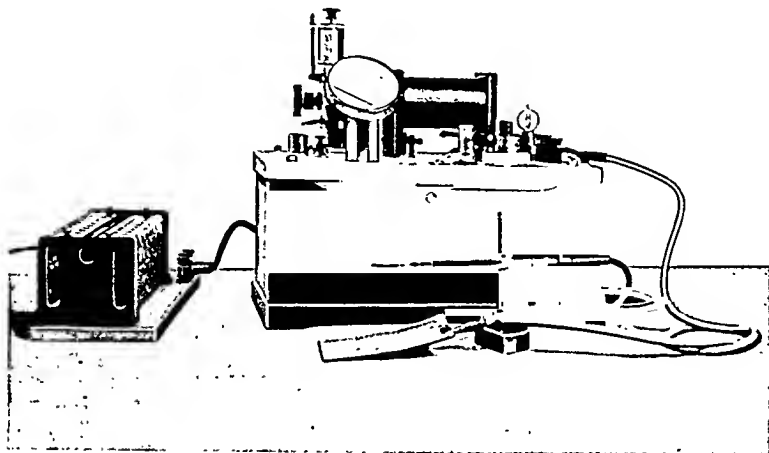


FIG. 362.—Diathermy apparatus, No. 6180 (Schall & Son).

Electrodes.—We have used several different types of active electrodes (*Fig. 363*).

1. The small platinum knife shown in *Fig. 363, a*, which I purchased from Messrs. Stille, of Stockholm.

2. A Bard-Parker knife with a terminal holder welded to the handle and with a blunted blade. The handle of this knife was insulated with rubber tubing (*Fig. 363, b*). We found that are dissection could be better carried out by using the back of the knife than by using the sharp edge of the blade. Rubber tubing of considerable thickness must be used for insulating this handle, otherwise there appears to be escape of electrical energy and irregular current.

3. A fine needle used with the ordinary vulcanite handle.

4. Recently we have obtained a new handle made of amber-coloured glass (*Fig. 363, c*), which is attached to a sterilizable cable, and to which can be

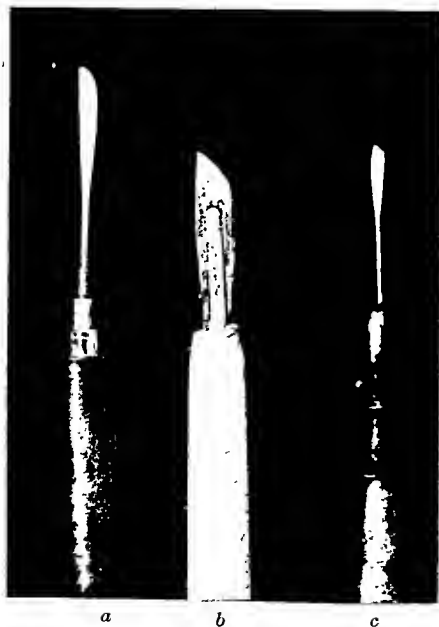


FIG 363.—Various types of electrode.

